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THE ACROPOLIS OF ATHENS.

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AT the beginning of every spring, a large number of tourists set out from the northern countries of Europe, particularly from England and Germany, to visit the cities where ancient civilization flourished, and to gaze at the ruined works of ancient art. At this period of the year Rome iso vercrowded. Athens, too, receives its quantum of sightseers, for at Piræus every incoming vessel discharges a swarm of pilgrims to the shrine of Greek art. Guide-book in hand, tourists wander through the ruined halls of the Acropolis in search of ancient examples of the beautiful in art.

Athens itself is quite modern and possesses but little attraction for the traveler. A Turkish provincial town with hardly 2,000 inhabitants, the old Greek metropolis, after the War of Independence in 1830, was entirely rebuilt, and now its population numbers 112,000.

With Rome, Athens cannot be for a moment compared. On the other hand, Rome, in spite of all its ruins, has nothing similar to the Acropolis rising far above the city and encompassing in so small an area so many examples of classic art. And the Acropolis is, after all, the goal of all tourists.

The Acropolis, with its steep rocky walls, rises to a height of 200 feet above the level of the city, and on it there stands the Temple of Pallas, the Propylæa, the wonderful Parthenon, and the Erechtheum, the oldest sanctuary on the citadel. The Acropolis is ever open to the tourist. At pleasure one can roam about, admiring, thinking, sketching, painting, or studying.

The only restriction placed upon the visitor is the law forbidding the mutilating of the statues or buildings, a practice to which relic-hunters of the gentler sex are much given. Vandalism of this nature is entirely unnecessary, for at all gates there are Greeks enough offering such relics for sale.

After much haggling, a souvenir can be obtained for a comparatively small sum. Tourists of a romantic disposition often visit the Acropolis by moonlight, permission having first been obtained from the proper officials.—Das Buch für Alle.

WILSON'S PREHISTORIC ART.—I.

ART and science have in these later days become closely connected. Artists of all countries and periods are conditioned by the circumstances in which their lives are passed and by the ideas prevalent among their peoples. Thus, art history becomes a function of social history and cannot wisely be disregarded by the student of history of the human race. The ancient works of art bring us into contact with bygone peoples and are often the only thing by which we can approach far distant civilization lying silent on the field of time. Thus, the study of art history becomes a branch of scientific inquiry, and it must be pursued by scientific methods if results of scientific importance are to be achieved. In general it may be said that "art" is the manifestations of human emotions externally interpreted by expressive arrangement of form, line or color, or by a series of gestures, sounds or words governed by particular rhythmic cadences. This definition is perhaps as satisfactory as any which can be obtained, though we doubt very much if an ideal definition of art can be given. If we asked the greatest mural painter or the greatest sculptor "What is Art?" we immediately find the great practitioner totally at fault, and "What is Art?" is a fertile subject for the writer on æsthetics. Each art is the peculiar language of a more or less extensive category of the ideas and sentiments to which it alone is able to give adequate expression. A work of art is, or should be, one which is the expression of its maker's delight. It excites the nerve sense and produces sensations of pleasure. We all hear the artist's ideal through his work, and the success of his effort depends upon the clearness with which his perception of his ideal is expressed and on his ability to translate and render this perception correctly. A copy, however accurate, is not art. Art is susceptible of several divisions; a common one is found in decorative and industrial art. Art deals with drawing, engraving, painting, architecture, sculpture, music, poetry and the drama. When it is in the singular form, the word art relates to fine arts; when in the plural, to industrial art. This linguistic distinction is continued in the distinction of the workman; the one is an "artist," the other is only an "artisan." Not unfrequently a work of art begins in industrial art and ends in fine art. The decoration in the Congressional Library at Washington is an example; much of the work began with the stonecutter and was finished with the sculptor; many of the wall decorations began with the common house painter and were continued by the greatest painters which America has ever produced, until the whole building forms one of the most remarkable groups of decorative painting and sculpture which the world has ever seen. So much for generalities. The craving for decorative art and the desire for things beautiful are the common heritage of mankind. Many writers have speculated upon the origin of this craving and have believed it to be contemporaneous with the origin of art, and they have declared its discovery to be as impossible as the discovery of the origin of gravitation. In this, however, they have overstated the case and deceived themselves and this fact is abundantly proved in Professor Thomas Wilson's "Prehistoric Art; or the Origin of Art as Manifested in the Works of Prehistoric Man." The author has written a most remarkable book which has already taken its place among the standard works upon archæology and the history of fine arts. Owing to his position as Curator of the Division of Prehistoric Archæology in the United States National Museum, he has had abundant material to draw upon which renders his book of unique importance. It is published by the Smithsonian Institution as a part of the Report of the National Museum for 1896. It is splendidly illustrated by 325 engravings, and we know of no book in the English language which treats of the subject in anything like the masterly manner in which Professor Wilson has brought together and collated his facts. The term "Prehistoric," as used in Professor Wilson's monograph, is used in the ordinary and usual sense as being prior to history, that is, meaning, of course, before the beginning of human history and as history can only be preserved in writing this means before written history. Prehistoric science does not depend upon historical records, but is contemporaneous with the events recorded, which are based upon the evidence of the objects themselves. Their discovery and the birth of the science of prehistoric anthropology lie within the present century. Prehistoric anthropologists have investigated these objects and the various deposits containing them as to, 1, their human origin; 2, the geologic age of the stratum in which they are found; 3, their original deposit in that stratum at the time it was formed (that is to say, an absence of intrusion or disturbance); 4, the association and superposition of implements and objects of stratified deposits; and by the knowledge and experience thus obtained they have determined that man made these objects and therefore he existed in these localities in times of high antiquity. The monograph to which we have referred deals with the art of making and decorating these objects.

The earliest manifestations of human art consisted of the chipping of implements of flint, practically the first known to have been made or used by man. They belong to the Paleolithic period of the Stone Age. This period has been divided according to progress and human culture and divers names have been given thereto, following the taste of the writers or discoverers, such as the epochs of the Cave Bear, the Mammoth and the Reindeer. In later days the tendency seems to have been to divide them into the Alluvium and the Cavern.

All authorities are agreed, however, that all these epochs belong to the Quaternary geological period; that they were earlier than the present geologic period, and that they came to an end before its beginning. These epochs seem to have brought forth the earliest examples of æsthetic art. The man of this time has passed for a savage, and he doubtless was one; he had no tribal organization, no society, no religion or belief in the future state; he did not bury his dead, he erected no habitation, he built no houses, he was a hunter and fisherman, and dwelt in no villages except such as could be called from a number of people living in a cavern for the purpose of shelter, yet he occupied the highest rank as a flint chipper and later as an engraver on bone and ivory. His materials were the bone, horns and tusks of the animals he killed. His tools were sharply worked points or gravers of flint. Most of the specimens of art work are found in caves which have been his habitation. Specimens of the earliest time have mostly been found in the caverns of central and southern France, and number some four hundred specimens. They have mostly been protected by stalagmitic or other processes of induration. A few specimens of the art work of the Paleolithic period are purely decorative, and without attempt to make representations of anything, but for the most part the objects were the animals of the period and locality. Many animals now extinct were represented, and in this way the knowledge of their appearance has been preserved. The animals most frequently engraved were the mammoth, the cave bear, the Irish elk, the musk ox, reindeer, chamois, mountain goat, auroch, horse, deer, and similar animals, and finally man. The marine animals were well represented—the seal, sea-lion, tortoise, turtle, fishes and serpents. Some of the objects thus treated were purely ornamental, while others were utilitarian; *bâtons de commandement*, poniard or dagger handles and similar specimens were for utility, while other specimens were apparently intended as playthings, many of them are so broken as to afford no clew to their purpose. This was the art of the Paleolithic period. That of the succeeding periods, the Neolithic and Bronze ages, was of a different style. It was almost entirely decorative, and was etched or cut on pottery and bronze objects of utility. During this period there was not the slightest attempt on the part of the artists to represent living or material objects. The decorative art, at that period, consisted almost entirely of designs from geometric forms, as squares, circles, lozenges, chevrons, herringbones, zigzags, and crosshatch. The "swastika" seems to have been used throughout the latter period and it is believed to have been a symbol representing good luck, good fortune, long life, much happiness, etc., and to have been the first and earliest symbol in use among men.

The Neolithic and Bronze periods brought about an entire change in the culture of man as well as in art; he became sedentary, having a local habitation and place of residence; he became an agriculturist, as well as a hunter and fisherman. It is barely possible that he had a religion. He built houses, constructed forts; he built tumuli, mounds, and dolmans, and erected great stone obelisks, sometimes in groups and lines. He acquired the art of and became an adept in chipping, grinding, polishing, and drilling stone, specially the hard flint and tough jade, of which he left some magnificently wrought specimens. A few whistles have been found belonging to the Paleolithic period, but the greater proportion of them belonged to the Neolithic period and to the Bronze age. The American Indians and those of the West Indian Islands were in the Neolithic stage of culture, and their decorative art was practically the same as of the same age in Europe. They excelled their European brethren, however, in making rude drawings and pictures, principally petroglyphs, many of them doubtless ideographs telling a story. They often reproduce the human figure, which the European rarely did. The aborigines of Mexico, central and northwestern part of South America, although still in the Stone Age, reached the

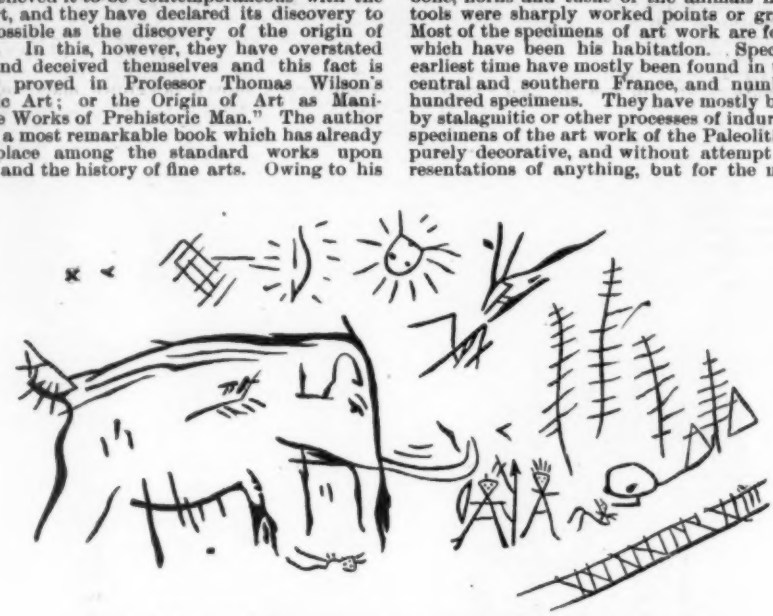


FIG. 1.—THE LENAPE STONE, WITH FIGURE OF MAMMOTH.

FIG. 2.—FULGER SHELL, WITH FIGURE OF MAMMOTH.

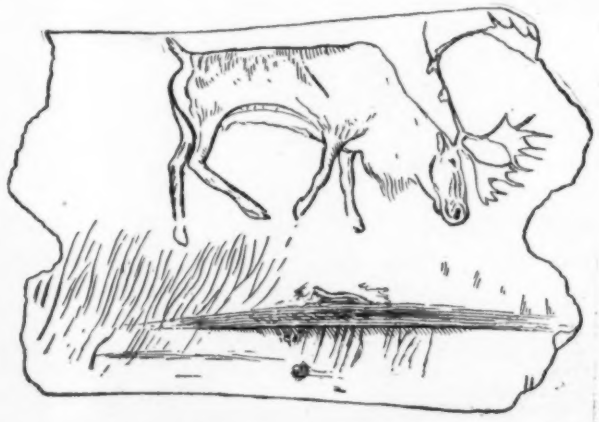


FIG. 3.—REINDEER BROWSING—ENGRAVED ON REINDEER ANTLER.

higher civilization, mainly manifested by their sculpturing of stone, the erection of extensive and magnificent temples, and their ideographic language.

In his important monograph Prof. Wilson presents no theories, his intention being to present facts from which arguments can be made and theories built. The sociology of prehistoric man is not touched upon and no *a priori* arguments are introduced to explain the psychology of prehistoric man, nor has any philosophic treatise been attempted. The monograph deals entirely with prehistoric art and does not deal with prehistoric anthropology. That he was wise in limiting himself is abundantly shown in the eminently scholarly monograph which demonstrates that the author has a most comprehensive grasp of his subject. He first deals with the Alluvium and the chipped Paleolithic implements which have been found in it, then the subject of contemporaneous implements in the United States is treated, and then the implements of the cavern period are considered. Then the subject of engravings on bone, horn, and ivory is treated. This epoch is most important in the history of art, marking as it does the earliest human expression of the beautiful. It has been said that this expression marks the first step in evolution from savagery. Some of the most remarkable designs come from La Madelaine, France, which has given rise to the Madelainian epoch, which is another name for the Reindeer epoch. The art of this locality was indigenous; it was not an imitation and seems not to have been borrowed nor to have migrated. It consists sometimes of rough attempts at sculpture or rather decoration in the round, and sometimes of etching or engravings on stone, bone, or horn.

The subject of engraving is very fully treated in Prof. Wilson's book, and he gives examples of flint gravers and decorative geometric and conventional designs produced with their aid. The implements and utensils for every day use were decorated with an art by no means contemptible. The ornamentation of harpoons, daggers, and similar objects shows an appreciation of decorative art as applied to household or domestic uses not unworthy of the nineteenth century. The animals of this period were represented in great number, about three hundred specimens having been discovered, comprising nearly every animal known. There

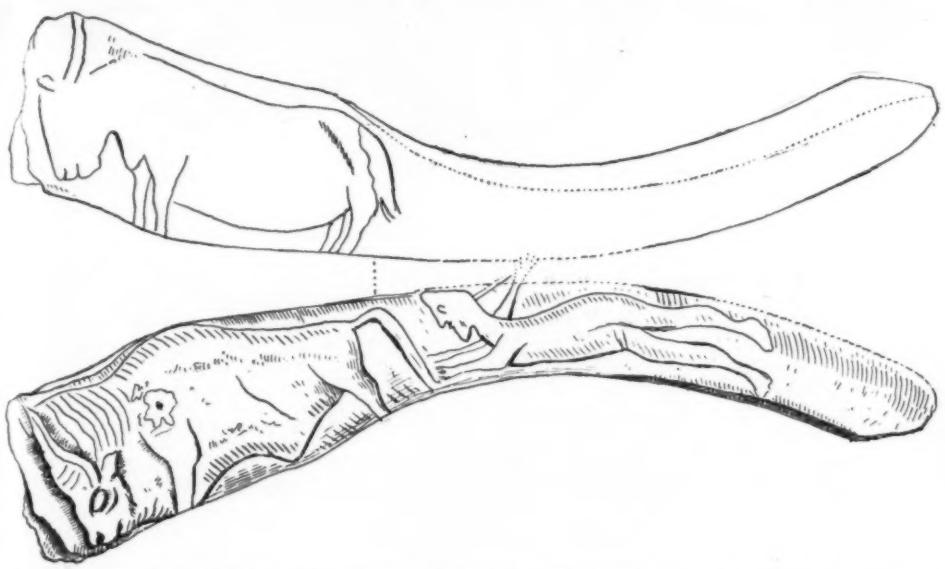


FIG. 4.—BISON AND MAN ON REINDEER ANTLER—A PREHISTORIC HUNTING-SCENE.

were some reptiles, more fish, a few birds, and many mammals. The reptiles were scarcely determinable, but the fish, the salmon, the trout, and the brochet, have been recognized. The principal animals are the cave bear, mammoth, reindeer, horse, ox, deer, mountain goat, antelope, chamois, wild boar, wolf, fox, bear, lynx, otter, seal, walrus, and rabbit, and to this list of animals man must, of course, be added. The museum at Foix has an excellent outline of the cave bear, engraved on a flat, oval pebble, and the mammoth is splendidly represented by an engraving on one of its own tusks; this is in the Museum of Natural History at Paris and shows no mean ability of the draughtsman. Certain drawings of the mammoth have been found in the United States which are claimed to have been made by the aborigines, and our first engraving represents the celebrated "lenape stone," a slate gorget with figures of a mammoth or mastodon engraved thereon. This was found near Doylestown, Bucks County, Pa., and is the property of H. D. Paxson. There has been considerable contention as to the genuineness of this object, but Prof. Henry C. Mercer, Curator of American and Prehistoric Archæology, Museum of the University of Pennsylvania, has examined the subject for many years and has found no reason to doubt the genuineness of the lenape stone, which has been questioned. Our second engraving shows another aboriginal drawing of a mammoth in America. It was found in the neighborhood of Holyoke Station, Del., on the surface of a tilled field which had been covered for manuring purpose with peat taken from the fallen forest layer in one of adjoining estuaries of the Delaware River. It somewhat represents the famous mammoth of La Madelaine and might have been done with the same kind of flint gravers. It is on a fulger shell indigenous to America and found on the coast from Delaware to Florida. The authenticity of the engraving has also been attacked. It presents no traces, however, of modern work, and until some proof is brought forward it will be considered as an example of very early aboriginal work.

Our third engraving represents the reindeer browsing. This specimen was found in the cavern of Thayingen near Lake Constance, Switzerland. It is engraved upon a piece of reindeer antler and was possibly the fragment of a *bâton de commandement*. The piece and rejected pieces. During this period there does not appear to have been any care or preservation of anything for future generations, for there were no tombs, no burials, no monuments, and except the caverns, no habitations. But in the fragments we can recognize the artistic feeling of the people. It is even contended by some investigators that different schools of art can be recognized in different localities, so that there is little wonder that the subject has given life to much speculation by philosophers, psychologists, and even anthropologists. They have abundant room for speculation and theorizing, for we are dealing with the prehistoric, where there is no history, no written record, no record at all other than these objects.

The manner of working seems to have been as follows: With the aid of flint instruments which may have been knives, flakes, points, scrapers, or whatnot, the surface of the material was prepared by the removal of the outside or rough portion. The reindeer horn was preferred to that of other deer probably because its surface was smooth and firm. These pieces of flint or similar ones were always found associated with engravings; the surface having been prepared, the objects to be represented were outlined probably by marks with the graver, cutting away the substance to a greater or less depth according to the sketch desired; the knives, flakes, and gravers may have been inserted in handles or operated directly by hand. No evidence has been found of the actual employment of a handle. Scrapers are more likely to have been so used, for the same implements inserted in a handle has been employed in modern times by the Esquimaux. In the sculptures, the surface after having been reduced to proper form seems to have been polished by rubbing, and accordingly there is found just such an instrument as would perform this service. It is a piece of flint rudely chipped into the general form of a man's forefinger. The materials are stone, ivory, bone, horn, and wood. We have little or no proof of wood being used. Ivory was employed principally for sculpture and horn for the engraving.

While the art products of Paleolithic man run principally to sculpture and engraving, there is evidence of his acquaintance with and practice of the art of painting. Stones have been found which were artificially colored with iron peroxide; the pigment was ground and kept in shells and in cup stones. Specimens have been found with the paint still in them and with spatulas of bone. The color was red and about the color of iron rust. The figures consisted of dots, zigzags, crosses, circles with a central dot and others of similar design in great number. The painting can best be described by supposing much of the work to have been done with light touches of the finger. They may possibly have formed a numerical system, still others may have been alphabetic or ideographic signs; still others symbolic. In our present state of knowledge, they represent man's earliest use of color for purposes of decoration and consequently were the very beginning of the art of painting, crude though it might be.

A few words as to the characteristics of the art of the Paleolithic age may not be out of place. It has already been said that there were some geometric designs. These were by lines or dots, seldom in the form of a cross, triangle, square or circle. They consisted of parallel lines, sometimes crossed, sometimes drawn in different directions, zigzags, chevrons, and sometimes the double chevron, giving it the appearance of the letter X, and on some of the long straight implements of bone appear long undulating wavy lines. In all these combinations of figures, none have been found which seem to have any meaning or form or any letter, word or hieroglyph. They do not correspond to any sign, ideographic or hieroglyphic. The cross is not found; there is no representation of sun worship, nor of the sea, nor of any divinity good or bad.

The designs, whether of drawing, engraving or sculpture, seem to have been original in so far as they were neither copied from other drawings nor adapted from other schools or masters. They do not seem to have been composed pieces but drawings made direct from nature with the original before the eye of the artist. There have been found in Western Europe about four hundred specimens of this engraved and sculptured art work belonging to the Paleolithic period. Of these four-fifths are representations of animals, and discoveries of Paleolithic art have been made continually in Western Europe and these discoveries show the correctness of former conclusion and the genuineness of foreign discoveries as well as the long and extensive human occupation in Paleolithic times. We have now completed our necessarily brief review of the first part of Prof. Wilson's monograph, and our next issue will deal with the Neolithic period.

NEW METHOD FOR THE PRODUCTION OF HIGH TEMPERATURES, AND FOR THE PREPARATION OF DIFFICULTLY FUSIBLE METALS, FREE FROM CARBON.

By M. GOLDSCHMIDT.

THE author first passes in review the different researches which have been made on the use of aluminum for the production of high temperatures, and then describes the method he has adopted.

We know that the combination of aluminum and oxygen gives rise to an extremely violent reaction, of which the temperature is estimated to be about 3,000° C. To utilize this temperature practically, the principal difficulty seems to be in regulating the reaction by means of which the work is performed.

The first point to note is that there is no need to heat the whole of the reacting mass up to the temperature of ignition; it suffices to cause combustion at one single point. But in this there is still a practical difficulty to overcome. In the preparation of metallic chromium, starting with a mixture of oxide of chromium and powdered aluminum, this difficulty can be easily overcome by placing at a convenient point a small quantity of a mixture of aluminum with a more easily reducible oxide, or, better still, with a peroxide. Oxide of lead, oxide of copper, permanganate of potash, and other substances, may be used for this purpose.

The great advantage of this method is that it enables us to prepare the pure metals, free from aluminum; the only precaution to take is to employ a slight excess of the oxide to be reduced.

The process is capable of two principal applications. In the first place, the heat given off by the combustion of a mixture of aluminum and a suitable oxide can be used simply as a source of heat (for soldering, welding, etc.) In the second place, the reducing power of aluminum, at a high temperature, can be utilized in the preparation of pure metals and of alloys. In both cases the method of working is practically the same.

If we only desire to produce a moderate heat, the reacting mass is diluted by the addition of some inert substance, which at the same time prevents the fusion of the mixture. A very good mixture of this nature is composed of aluminum and some cheap oxide, such as oxide of iron, sand, etc., to which may be added lime, magnesia, etc. If, on the contrary, we wish to produce a reduction to the metallic state, we must be careful not to use too great a proportion of oxide, in such a manner that the heat given off by the reaction will melt not only the reduced metal, but also the slag. This latter will then protect the metal against any oxidizing action of the air.

I now give a few experiments which form so many interesting applications of this process.

A rivet weighing 3 kilogrammes, such as are employed in bridge making, is embedded in a mixture of oxide of iron, sand, and aluminum powder. The whole is plunged in sand contained in a wooden box. On top of the aluminum mixture, which must just emerge from the sand in the box, we place a small lump of a mixture of aluminum powder and an easily reduced oxide, in which is fixed the end of a short piece of magnesium ribbon. The reaction is started by lighting the free end of the magnesium, and we then immediately place more sand on the top of the mixture, so that as little heat as possible may be lost. If at the end of a few moments we empty out the contents of the box, the rivet will be found to be quite red hot and ready to be forged.

Working in an analogous manner, we can weld together steel tubes of 2·5 cm. diameter, and the expense will not be more than twopence. We can even fuse together two bars of soft steel.

By diminishing the quantity of inert material used in the preceding experiments, iron can be easily melted.

To reduce oxide of chromium it must be mixed with

a suitable quantity of aluminum, and placed in a crucible brasked with magnesia. The reaction is started in the manner described above, and we go on adding the mixture until the crucible is full. After cooling, we break the crucible and take out the ingot of metallic chromium. The author has presented to the German Electrochemical Society a block of metallic chromium weighing 25 kilogrammes, prepared by this method.

By arranging two orifices in the crucible, one for the introduction of the mixture and the other for the escape of the metal, we can make the operation continuous, as in the electric furnace.

According to the author, the temperature obtained under these conditions is higher than that realized in the electric furnace, and we can reduce a given quantity of a metallic oxide in a much shorter space of time, and, further, the metal obtained is entirely free from carbon and carbides. The slag (alumina) obtained can be used over again for the production of aluminum, or it may be utilized as a polishing material; it has, in fact, great advantages over emery.

Nearly all the metals can be reduced by this method, and the return is almost theoretical. We can also prepare alloys such as those of chromium and manganese, copper and chromium, etc., by the same method.

For the preparation of pure metals it is necessary to use only pure aluminum, but for simple heating operations the metal at 50 per cent. purity will suffice. Besides the oxides we can also reduce the oxysalts of certain metals.

The author looks upon aluminum as a heat accumulator, since its utilization as a reducing agent allows of the regeneration of a quantity of energy corresponding to that required for its precipitation.—Zeits. für Electrochemie, 1898, iv., 21, p. 494, and republished in Chemical News.

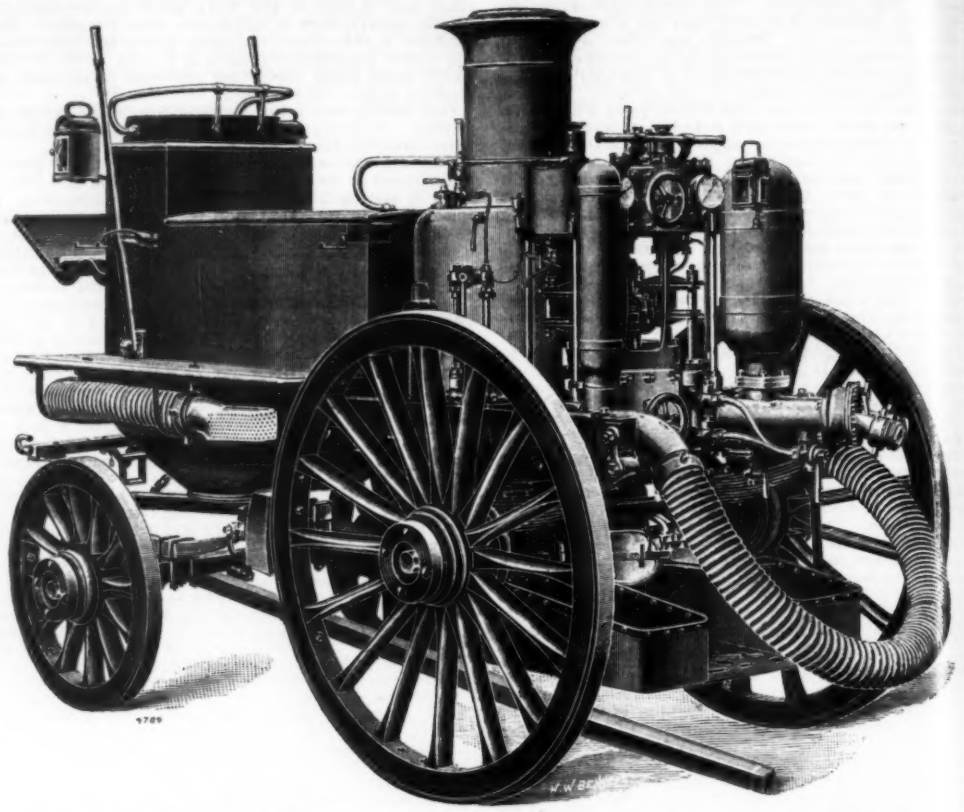
DOUBLE-CYLINDER STEAM FIRE ENGINE, LONDON COUNTY COUNCIL.

WE illustrate herewith one of the latest steam fire engines added to the plant of the London County Council. This engine is one of Merryweather & Sons' "Greenwich Gem" type, and is the first of the pattern supplied for use in London. Its capacity is 400 gallons per minute, and it will discharge a jet of water $1\frac{1}{8}$ inches in diameter to a height of 170 feet, or as many as four smaller jets simultaneously. There are several special features about the construction of this machine worthy of notice. The machinery is fixed at the rear of the boiler, being so designed that it is above the firedoor, thus permitting lighting and stoking at the rear from the engineer's footplate when en route to a fire, and when at work enabling one man to stoke, attend to the engine, look after the feed and delivery valves, and all other parts requiring attention, without moving from his place in the rear.

Another special feature is the construction of the pump. This has two barrels and is double acting. The air space between the valves has been reduced to a minimum consistent with the provision of ample passages for the water. The pump valves, both for suction and delivery, are all arranged in one central chamber accessible by removing one cover, and the valve seats are kept in place by one nut between each pair of suction and delivery valves, so that the removal and examination of the whole is only a matter of a few minutes. The working parts of the engine are entirely of steel, or a special bronze, and efficient means of lubrication are provided throughout.

The steam cylinders are fixed direct to the boiler, avoiding the use of steam pipes, and the pumps are connected to the cylinders by means of a gun metal distance piece (which also carries the shaft bearings) and steel stays, so that the strains when pumping are all self-contained. The boiler-feeding arrangements are very complete, consisting of feed pump taking water from main pump, another drawing its supply from a separate suction, a self-starting injector, and as an emergency feed the discharge from the main pumps may be turned into the boiler. The boiler is of Merryweathers' water-tube type, and is fitted with transverse and J tubes, and a water-jacket round the firebox. The working pressure is 120 pounds per square inch, and with the pressure 140 pounds per square inch can be maintained in the pump when required. The frame is carried on high wood wheels and laminated springs; the fore carriage is capable of locking right round, and is mounted on three springs arranged to permit traveling over rough roads without straining the frame or attachments. A large hosebox, forming a seat for the firemen, is fitted on the front part of the frame, so that when the box is filled with the hose and usual gear carried in a London fire engine, the machine is complete in itself, and can get to work without waiting the arrival of another vehicle.

Although this type of engine has only been introduced about two and a half years, it has been adopted by over thirty English fire brigades, besides several private landowners and numerous foreign customers.—Engineering.



DOUBLE-CYLINDER VERTICAL STEAM FIRE ENGINE, LONDON COUNTY COUNCIL.

CONDENSATION IN STEAM ENGINES.

THE condensation of steam in an engine results, as well known, in a saving of from fifteen to thirty per cent.; but the installation of condensing apparatus is costly, and requires the use of a certain amount of water that is not always at one's disposal.

M. F. Bohler, a constructing engineer, has devised an apparatus which he calls an ejecto-condenser, and which performs all the functions of an ordinary condenser. He has likewise arranged a refrigeratory (Fig. 1) that permits of always using the same cooled and purified water for condensation. If the quantity of water at hand is adequate, it is possible simply to install an ejecto-condenser; but if the contrary is the case, or if water is dear (as at Paris, for example), two apparatus, like those shown in Fig. 2, may be installed. The general model of the ejecto-condenser, as shown in the cartouche in Fig. 2, is formed of a cylindrical tube with an enlargement at the upper part. Upon the side to the left there is an elbow which is put in communication with the eduction pipe through which flows the exhaust from the engine. This elbow is provided with a valve box to prevent the return of water to the cylinder. At the top there is a handwheel that actuates a plug which regulates the admission of the cold water entering through the pipe that is seen open. Behind there is a cock which serves for the priming of the apparatus.

These ejecto-condensers may be employed with water under a head, or with a centrifugal pump for sucking up their water of condensation, or may be used directly for sucking up the water of condensation themselves. In the latter case they are specially arranged with a slide valve.

In Fig. 2 is shown the complete installation of an ejecto-condenser, with a refrigeratory, upon a steam engine. At the exit of the steam, after its action upon the cylinder, there is at *A* a three-way cock which permits of sending the steam into the pipe situated at the upper part or into the lower pipe that ends at the ejecto-condenser, *B*. The water comes from the cistern, *C*, through the pipe of the refrigeratory seen in front; and, while the engine is running, it is such water that mixes with the steam arriving at *B*, and that is sucked up by the centrifugal pump, *D*, and afterward forced under pressure into the refrigeratory, *E*.

In Fig. 1 may be seen a refrigeratory in section. At the lower part will be observed a cistern whence starts a pipe that runs to the ejecto-condenser. This is the pipe already spoken of. Above is situated the pipe that carries the mixed water and steam under pressure to the refrigeratory. At the entrance there is a vertical expansion tube which serves for the regulation of the pressure. The water then enters a series of atomizing nozzles, escapes in a spray and falls back into a cistern, from which it is afterward taken cooled

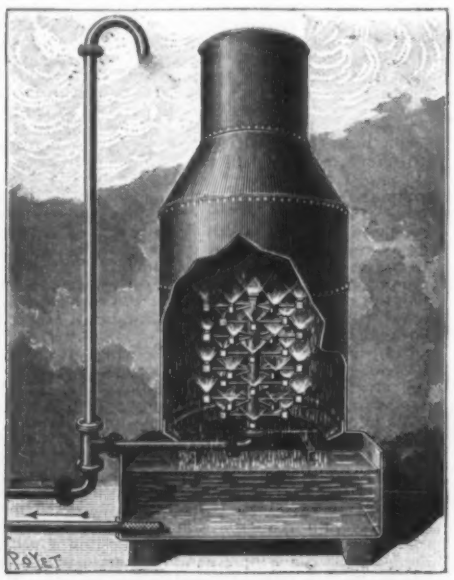


FIG. 1.—BOHLER REFRIGERATORY WITH A CHIMNEY.

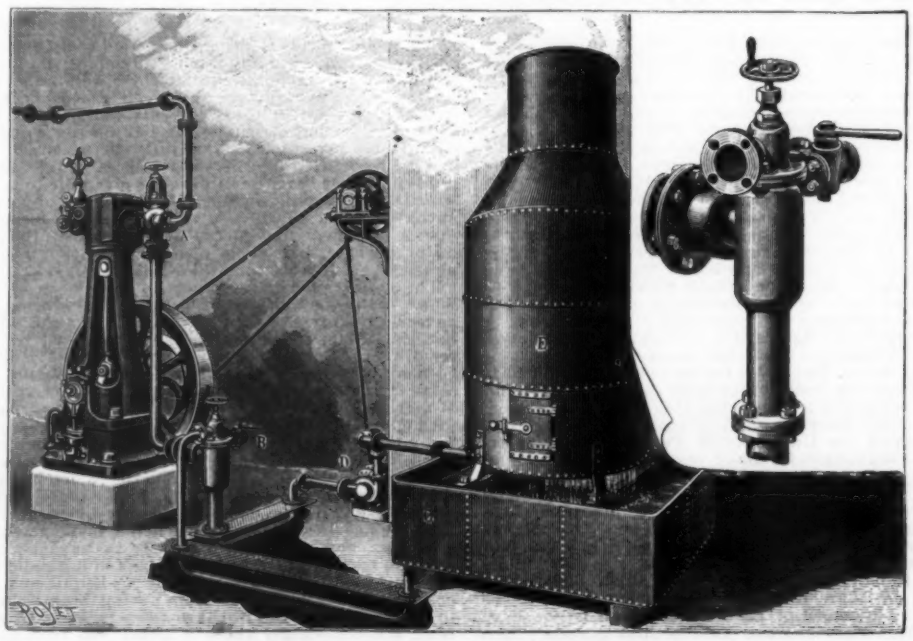


FIG. 2.—BOHLER EJECTO-CONDENSER APPLIED TO A STEAM ENGINE.

and purified. The nozzles, collectively, are placed in an iron plate jacket which completely covers them.

In the ordinary models, the refrigeratory is surrounded by blinds formed of slats supported by angle irons.

The water, upon escaping from the nozzles from bottom to top in a very fine spray, forms a blower and creates a very strong draught of air through the lower part of the iron plate chimney. The result is a perfect cooling. It will be remarked, moreover, that as the water is in a very finely divided state, all parts of it are cooled. Therefore, no steam remains.

The water is collected in a cistern at the lower part; but care is taken to purify it and to collect, through a waste pipe, the lubricating oil that rises to the surface. These refrigeratories take up but little space—say about a third of that necessary for an open air refrigeratory. Various models of these apparatus are provided for engines ranging from 15 to 1,000 horse power. In 15 horse power the discharge of water necessary is about 1,125 gallons an hour. The surface of the basin is 90 square feet. In 1,000 horse power the discharge of water reaches 80,000 gallons an hour, and the surface of the basins is 750 square feet.

The ejecto-condenser is set in operation by means of the steam that is sent directly into it through the cock placed at the side, which is closed as soon as the priming is effected. The pump afterward continues the suction of the cooling water and the forcing thereof into the cistern.

It is estimated that the use of the ordinary condensers with steam engines affords a saving of about twenty-five per cent. of fuel in a running with free escapement; but it is necessary to assure a discharge of water that may amount to about 75 gallons per horse and per hour, mixing condensers being, as a general thing, the only ones practical in cities.

The Bohler apparatus always utilizes the same water. The loss due to evaporation reaches about six quarts per horse and per hour; but it must be added that the condensed steam coming from the cylinders of the engine largely compensates for such loss. The waste pipe placed upon the cistern beneath the refrigeratory, and which removes the lubricating oil, serves likewise for getting rid of the water in excess, which, after purification, may be used for the boilers.

The second model of ejecto-condenser is not provided with a centrifugal pump. It primes itself and sucks up the water of condensation automatically.

The ejecto-condensers may be placed horizontally or vertically. Their level should always be lower than that of the cylinders of the engine, in order to permit the water of condensation to flow freely. So, too, the height of suction should not exceed a certain degree—say about twelve feet. In order to avoid losses of vacuum, the ejecto-condensers must be placed as near the engines as possible, or else the diameter of the conduit that runs from the engines to the apparatus must be increased.

These new condensers present great advantages. They cost only about half as much as the air pump apparatus. They have neither piston nor valve. They require no lubrication nor surveillance, and they produce a medium vacuum, which is shown by a diminution, by twenty-five inches, of the column of mercury.

As we have above stated, the installation of a condensation plant by means of the ejecto-condenser is very economical. Let us take as an example an engine of 100 horse power that will require a discharge of 7,950 gallons an hour. The cost of the ejecto-condenser alone will amount to $250 and the various accessories will cost about $185; to which must be added the freight charges and the expenses of mounting, etc. The cost of the refrigeratory and of the iron plate cistern will be about $600.

These apparatus seem to us interesting and of a nature to permit of advantageous applications in industrial installations. A large number of important applications has already been made of them, and the apparatus are in all cases operating satisfactorily.

For the above particulars and the illustrations we are indebted to La Nature.

SIX-COUPLED COMPOUND EXPRESS ENGINE.

A NEW type of express engine having six-coupled drivers has lately been put into service upon the Austrian State Railways, the first one of the new series, which are classed as No. 9, now hauling very heavy passenger trains over the Amstellen to Pontelba section with excellent results. This engine, nineteen of which are built or are being built at the shops of the Austro-Hungarian State Railway Association—late John Haswell—presents several interesting peculiarities of construction. In the first place, the cylinders, instead of being outside, as has been the usual practice heretofore on this line, are now inside the frames, notwithstanding their exceptionally large diameter—that is to say, 20⅞ inches and 31⅞ inches, as against the 19¾ inch and 29 inch outside cylinders of the precedent four-coupled express engines. The piston stroke has also been proportionately increased in these newer engines to 28⅜ inches in place of the 26¾ inch stroke in the four-coupled class; but the driving-wheels are decreased by 1 foot in the diameter—a trifle under 6 feet, viz., 5 feet 11⅜ inches—as compared with the eight-wheeled engines. The truck wheels are, however, slightly larger in diameter—3 feet 4¾ inches—and have the admirably long rail-base of 8 feet 8 inches, which, although less than in the eight-wheelers, contributes much, nevertheless, to the imposing appearance of the engine. The flexible wheel base of the six-coupled drivers is 12 feet 7¾ inches.

Owing to the lowness of the driving wheels and the considerable height of the boiler's axis—viz., 8 feet 6 5-16 inches, higher still than those of the four-coupled class—a boiler 5 feet 3 inches diameter has become admissible. Domes have been entirely dispensed with by Mr. Karl Gölsdorf in the design of these engines, and in their place above the boiler he has placed a cylindrical reservoir for dry steam, which adds very considerably to the capacity of the boilers for the reserve power so essential in mounting long and heavy gradients. A moderate steam pressure of 196 pounds is carried. The heating surface contained is 2237 square feet, 166·8 square feet in the fire-box and 2070·2 square feet in the tubes. The grate area is 33·3 square feet.

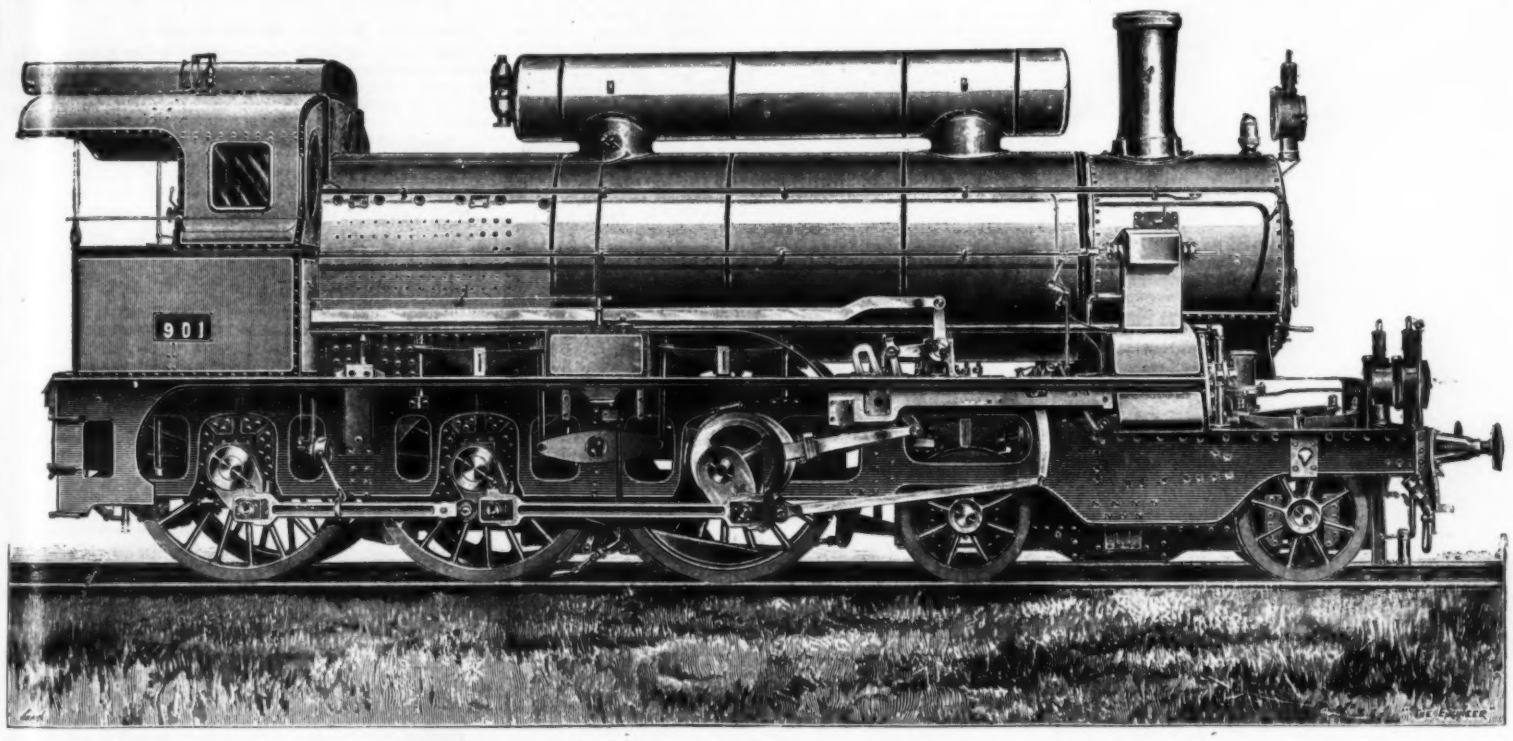
From the foregoing it will be seen that these Austrian locomotives fall very little short in point of size and power of modern American passenger engines of the trunk lines. In actual work these engines can haul loads of 400 tons behind the tender, up continuous inclines of 1 in 100 and eight miles in length, steadily maintaining a speed of twenty-six miles per hour to the top of the bank, developing in the work upward of 1300 horse power. Upon the Amstellen-Pontelba route there are many curves of 720 feet and 625 feet radius to pass, for which the bogie truck is permitted a play of 1¼ inch upon each side; the third coupled axle, moreover, has a lateral movement of ¾ inch on each side.

The engine has outside frames, but the first axle, which is the cranked axle and of a particularly strong design, is stayed by a central rib, or third frame, and central bearing. With such large cylinders, the only convenient position for the valve chests has necessarily been outside. Two perforations in the low-pressure valve face, admitting high-pressure steam direct from the boiler, dispenses with the need of such complications as special starting gears in compound locomotives, while allowing of cut-offs of up to and over 90 per cent. of the stroke.

The valve gearing is Heusinger's, but it will be observed that, in place of the lever which usually drives upon the valve rod from the crosshead of an outside cylinder, another arrangement has been compulsorily employed, taking its movement from the front end of the coupling rods. The regulator rod passes forward from the cab along the right side of the boiler to a regulator slide contained in a chamber on the dry pipe, just where the latter is brought through the smoke-box side to pass downward to the high-pressure valve chest under the cover of an external casing. On the receiver the air inlet valve is placed, and combined with the receiver safety valve, to be seen mounted upon the front end of the smoke-box.

These engines are equipped with the automatic vacuum brake, Gresham's sanding device, Haushalter's speed indicator, driven from the coupling rod beneath the cab; Nathan's No. 10 sight-feed lubricators, Friedmann's lifting injectors, and a train steam-heating apparatus.

A very large cab, 10 feet in width, is surmounted by a clerestory roof open at both ends, and thereby calculated quickly to clear the cab of even lignite smoke at such times as when the regulator is suddenly closed on a falling gradient. Tell-tale leak holes are perforated in the iron sheathing coinciding with the upper rows of the fire-box stays. A soot chute is fitted beneath the smoke-box. The chimney top measures 15 feet, and the horizontal steam reservoir 14 feet 2 inches from the rail. Equalizing levers are provided between the springs of the first and second driving wheels. The weight, when in full working order, under each pair of driving tires, is 14·2 tons (42·6 tons adhesive weight), and under the first and second pairs of bogie tires it is 12·8 tons and 13·8 tons respectively, or a total weight underneath the tires of 69·2 tons English.—Engineer.



COMPOUND EXPRESS LOCOMOTIVE, AUSTRIAN STAATSBAHN.

"**In conversation** with a gentleman who has just made a trip through western Indian Territory, I picked up," says a writer in Forest and Stream, "something new and interesting to me in regard to the habits of the prairie-dog and rattlesnake. This party said that a few weeks ago, while resting under a small tree in the Territory where there was a dog-town, he noticed a commotion among some dogs near him; they would run up to a place and peep at something and then scamper off. Looking to see what was the matter, he saw that there were about fifteen to twenty dogs around a rattlesnake, which at length went into one of the dog holes. As soon as he had disappeared the little fellows began to push in dirt, evidently to fill the hole up, but about the time they got enough dirt to cover the entrance the snake stuck his head up through the dirt and every dog scampered off to a safe distance, all the time keeping up an incessant barking. The snake slowly crawled to another hole about a rod distant and went in, and then up came the dogs again and went to work to push dirt up before them to the hole. This time they succeeded in their enterprise and completely covered the entrance to the hole, and then went to work, using their noses to tamp with and pounding the dirt down hard, after which they went away. My friend went to the place, and said he was surprised to find they had packed the dirt in solid with their noses, having sealed the snake well to the ground."

The highest church in Europe is said by The Home Magazine to be the pilgrimage chapel of S. Maria de Ziteit, above Salux, in the Swiss canton of Graubunden. It lies 2,434 meters above the sea-level—nearly 8,000 feet high above the forest, near the limits of perpetual snow. It is only open during the summer time of that region — or, as the folk thereabout reckon, from St. John the Baptist's Day to St. Michael's Day—and is used only by the Alpherds, who remain there through the summer with their cows and goats, and occasionally by hunters in search of the chamois and marmot. All the inhabitants of Salux climb up thither on Midsummer Day to assist at the first mass and hear the first sermon of the year, and there is also a crowded congregation on Michaelmas Day, at the last service of the year.

German actresses have to be careful how they wear male costumes. A young woman has been fined in Vienna for wearing a correct military uniform, which is not allowed by the Austrian authorities. In Germany, however, she would have been punished if the uniform had not been correct, the Kaiser's decree permitting military dress on the stage only when absolutely correct.

ENGINEERING NOTES.

The early example of a steam engine by James Watt, till recently at work in Dundee, but acquired as a memorial and example of old-time engineering by public enterprise, is now about to be housed and set up in the Barrick buildings, Dundee, where it will be in a situation well adapted to its preservation and to free inspection of all interested. The cost of housing and erecting the engine will amount to $2,500, and the fitting up will be done in such a way as to admit of electric motor power being applied for putting it in motion at any time desired.

The new mole at Ancona, Italy, is completed, but in consequence of the close proximity of the Custom House stores to the shore end of the mole, sufficient space is not available for turning the railway trucks employed in receiving cargo from vessels discharging alongside. A contract has accordingly been entered into with the builders of the mole for an increase of space, which will be practically an enlargement of the present quay way. The new addition will be 492 feet long, and the broad end 49 feet, gradually descending to 33 feet wide, and the contract time allowed is the present year.

The steel pipe line for the Indianapolis Water Works is made of ¼-inch plates in courses 6 feet long, there being two plates to each course. A peculiar feature of the construction is that angle iron stiffening rings are riveted outside the pipe at intervals of 10 feet. The pipe line takes the place of an old wooden flume from the upper canal, and furnishes power to the water works pumping station and to several mills, the turbines at the pumping station being under a head of 50 feet. The plates were rolled, punched, and dipped at the works of the Springfield Boiler and Manufacturing Company, of Springfield, Ill.

Experiments with a new explosive called kallenite were lately made near Sydney, N.S.W., and are said to have been successful, says The Engineer. Kallenite differs from dynamite in that, instead of being largely composed of an incombustible base like infusorial earth, eucalyptus leaves and ti-tree bark are used. These contain a large quantity of gas, and their combustion adds to the force of the explosion. The whole compound, in short, is explosive, and this, it is claimed, adds to its efficiency an economy at the same time. The absence of smoke is said to render kallenite a desirable explosive for military purposes.

The Street Railway Journal describes a form of wire rope filler for filling the interstitial spaces of ropes. In a stranded rope of six strands, with a central core, there is a good deal of space for the filling, which it is claimed will exude and prevent injury from acids or water. The question is, How long such a filling will retain preservative virtues, and if it is suitable for ropes of small size, such as span wires? There are thousands of miles of small span wire exposed to every vicissitude of climate and smoke, and the efficacy of galvanizing is more or less doubtful. Zinc does not give an adherent flexible coating on a wire of iron or steel, and we know of nothing that does. A durable preservative is wanted which will not demand constant attention.

A new method of chimney construction has been devised by Mr. S. E. Loring, of Syracuse, N. Y. A chimney 150 feet high erected at this place has a frame constructed of ordinary 3-inch pipe and fittings which rest upon a grill of T-rails embedded in a block of Portland cement concrete, which incloses the columns to a height of 8 feet. The construction of the frame is simple. On the interior of the chimney the frame is inclosed by hollow tiles of porous terra cotta, and the outside is faced with pressed brick. The tile is sufficiently refractory to make the use of fire brick lining unnecessary. The stack illustrated is 8 feet square inside, and cost less than $3,000. The inventor claims that tests have shown the non-conducting value of a 9-inch hollow porous terra cotta tile to be equal to that of not less than 28 inches of solid brick work, while in volume and weight of solid clay it does not exceed 3½ inches. The weight of the stack wall per lineal foot does not exceed that of a solid 8-inch wall.

A technical commission in France has made a favorable report upon a scheme for constructing a mountain railway to the top of Mont Blanc, and it is not improbable that the project will carried out, as the various rack lines up the Swiss peaks have been successful from almost every point of view. The most difficult part, says The Mechanical Engineer, would be the 3¼ miles from Aiguille du Gotes to the summit, but here the line would be carried on a special gallery which, though laborious of construction, is deemed the most practical method. There are difficulties resulting from the altitude in the matter of air, cold, etc.; but these, it is thought, would be overcome after some time of residence there. The line will start from Chamonix, and extend almost to the apex of the great mountain, the length being 6¼ miles, and the total cost, as a result of a preliminary survey, is put at $2,500,000, of which one-half is due to the gallery near the top. It is proposed, of course, to utilize some water power, and the hydro-electric installation is put down at $125,000.

Ever since electricity came largely into use as a motive force, there has been a large and increasing demand for pure copper, as that metal has much higher conductivity than any other that can be had for the purpose. The fact, however, that it has been impossible to make sound castings from pure copper has added very much to the cost of electrical machinery. It has been the custom, where pure copper was used, to employ rolled copper, sawing out the shapes needed. Alloys of copper and some other metal, as zinc and aluminum, has been used for making castings, whose conductivity was generally about 50 per cent. or under (the highest ever reached being but 77½ per cent.), which rendered it extremely unsatisfactory. In view of these facts, the announcement that Mr. B. S. Summers, chief chemist of the Western Electric Company, of America, has discovered a process by which copper castings having a conductivity of an average of upward of 90 per cent. can be made, is of sufficient importance to mark an epoch in metallurgy. It is said that in one machine, where a casting weighing 3,900 lb. was used, a 2,600 lb. casting was substituted.

MISCELLANEOUS NOTES.

Dr. Murray expects to have more than half of the new English dictionary published by the end of the century, up to the middle of the letter L. The letter that has given the English compilers the greatest difficulty is, curiously enough, the letter H.

Turin held an international exhibition last summer which will remain noteworthy through the receipts having exceeded all expenditures by $120,000. No sooner was this result known than the Italian government sent in a tax bill, demanding 10 per cent. of the profits.

It is reported from Berlin that valuable marble, said to be equal to Carrara marble, has been found in German Southwest Africa. It is asserted that the beds are most valuable, owing to their size and thickness. The government has sent a committee of experts to report on the find, believing that the discovery will enhance the commercial value of the colony tenfold.

A paper on the temperature over the floor of the ocean and the maximum and minimum temperature of the surface of the ocean was read lately by Sir John Murray, before the Royal Society of Edinburgh. The results show that 92 per cent. of the bottom water of the ocean had a temperature under 40° Fah. Higher temperatures were met with in areas between the shore and the hundred-fathom line. As regards the surface water, 87 per cent. of the maximum temperatures and 75 per cent. of the minimum temperatures were above 40° Fah.

In recent experiments, Messrs. Lüdenburg and Krügel find that the density of liquid air is less than that of water. Air freshly liquefied and found to contain over 50 per cent. of oxygen had a specific gravity 0·995. As the nitrogen evaporated the specific gravity increased, so that after two or three days the liquid containing 94 per cent. oxygen had a specific gravity 1·112. From the data obtained it is calculated that if atmospheric air could be liquefied without change of composition, its specific gravity at its boiling point would be between 0·87 and 0·90.—Engineering and Mining Journal.

The largest tree in the world is to be seen at Mascali, near the foot of Mount Etna, and is called "The Chestnut Tree of a Hundred Horses." Its name arose from the report that Queen Jane of Aragon, with her principal nobility, took refuge from a violent storm under its branches. The trunk is 204 feet in circumference. The largest tree in the United States, it is said, stands near Bear Creek, on the north fork of the Tule River, in California. It measures 140 feet in circumference. The giant red-wood tree in Nevada is 119 feet in circumference.—Ladies' Home Journal.

At the present time pencils are being made in Tennessee from slate dust and other ingredients moulded under hydraulic pressure according to a patent formula. These pencils are free from grit, and do not scratch like those that are cut from solid slate, and which are imported chiefly from Germany. Efforts have been made periodically in America to establish a "solid cut" slate pencil industry, more particularly in Vermont and Virginia, but without success, owing to the cheapness of the imported article. However, the manufacture of pencils from slate dust is steadily increasing. One large concern in Chattanooga, Tenn., informs us that its output in 1898 aggregated 25,000,000 pencils, as against 13,000,000 in 1897. These pencils are shipped to almost every civilized country in the world.

Because of the great loss by fire which occurs every year in the Russian villages, the government is making efforts to induce the peasantry, says The Saturday Review, to employ some less dangerous material than straw thatch for the roofing of their izbas. There has already been a large increase in the use of shingle, and this has led to a considerable importation from Belgium and Germany, and also from the United States, of simple and inexpensive shingle-making machines, for use in rural districts. German manufacturers, whose "commercial intelligence department" is remarkably well informed, are now making redoubled efforts to meet the immense demand anticipated. An improved and inexpensive hand fire engine is also being provided. Roofing felt or paper is very generally used under the shingle, and the demand for this is also increasing.

The total length of rivers and canals in European Russia—according to the Revue de Statistiques—is 67,596 miles, of which 46,202 miles are available for use, 30,338 miles navigable and the remainder for floating purposes only. The canals aggregate 499 miles in length and canalized rivers 648 miles. The Volga alone accounts for nearly 50 per cent. of the navigable waterways. The average length of time for navigation varies naturally according to geographical distribution; it may be reckoned at about 158 to 220 days for the Neva and the Ladoga and Onega lakes; at from 221 to 240 days for the Niemen; at from 213 to 244 days for the Western Dwina, and at from 156 to 190 days only for the Northern Dwina. During the last five years the Russian government has devoted a sum equal to $30,000,000 to the improvement of navigable waterways.

Regenerating Air.—A discovery of a substance capable of removing carbonic acid gas and water from respired air, and at the same time restoring oxygen to it, was recently communicated to the Académie de Médecine. Subsequently two communications on the subject appeared in Comptes Rendus. MM. Desprez and Balthazard describe experiments in which guinea pigs and a dog were inclosed in a limited quantity of air, together with a quantity of sodium peroxide, which decomposed in accordance with the equation $2Na_2O_2 + 2H_2O = 4NaOH + O_2$; the carbonic acid gas of the air being absorbed by the caustic soda formed. Parallel experiments were carried out without the peroxide, and it seemed to be proved that this substance was effective in keeping the air respirable. M. d'Arsonval points out that 17 years ago he devised an arrangement for the gradual evolution of oxygen as required, in a closed space, by means of an intermittent flow of hydrogen peroxide into chromic acid; the carbon dioxide being absorbed by soda lime.

SELECTED FORMULÆ.

Bicycle Oil for Lubricating.—

Castor oil.
Kerosene, equal parts.

Bicycle Oil for Burning.—

1. Lard oil.
   Kerosene, equal parts.
2. Camphorated oil.
   Kerosene, equal parts.

Bicycle Paint (Glossy Black).—

1. Amber	8	ounces av.
Linseed oil	4	fl. ounces.
Asphaltum	1½	ounces av.
Resin	1½	"
Oil of turpentine	8	fl. ounces.

Heat the linseed oil to boiling point, add the amber, asphaltum, and resin, and when all melted, remove the heat and gradually add the turpentine.

2. Oil tar	4	ounces.
Asphaltum	1	"
Resin, powdered	1	"

Mix and dissolve with the aid of heat, care being taken to prevent contact with the flame.

Cement for Bicycle Tires.—

1. Gutta percha	1	ounce av.
Caoutchouc	2	"
Venice turpentine	1	"
Carbon bisulphide	8	fl. ounces.

Dissolve the gutta percha and caoutchouc in the carbon bisulphide and add the Venice turpentine.

2. Isinglass	½	ounce av.
Gutta percha	1	"
Caoutchouc	2	"
Carbon bisulphide	8	fl. ounces.
3. Fish glue	1	part.
Gutta percha	2	"
India rubber	4	"
Bisulphide of carbon	32	"

Cement for Mending Rubber Goods.—

The following method of repairing the cracks or fissures in articles of caoutchouc is given in L'Industrie Textile. First clean very carefully the surface of fissure or parts to be united, and apply a cement composed of:

Bisulphide of carbon	26	parts.
Gutta percha	2	"
Caoutchouc	4	"
Fish glue	1	"

The edges of the rent should be kept together by means of thread, and the article left to dry. At the end of from twenty-four to thirty-six hours the binding thread may be removed and the cement, which may have squeezed out of the fissure, cut away.—India Rubber World.

Tire Cement Containing No Carbon Bisulphide.—

A.

1. Caoutchouc, fine shreds	1 ounce.
Chloroform	30 "

B.

Caoutchouc, fine shreds	1 ounce.
Resin	3 drachms.
Venice turpentine	90 grains.
Oil turpentine	4 fl. ounces.

For the solution B, the rubber is shaved into small pieces and melted with the resin; the Venice turpentine is then added, and all is dissolved in the oil of turpentine. The two solutions, A and B, are then mixed.

2. India rubber	15	grains.
Chloroform	2	fl. ounces.
Mastic	½	ounce.

Mix the India rubber and chloroform together, and when dissolved, the mastic is added in powder. It is then allowed to stand for a week or two before using. —Bulletin of Pharmacy.

Depilatory Cream.—A depilatory cream which is used largely in the New York hospitals for the removal of hair from the skin previous to operations has the following formula:

Barium sulphide	3 parts.
Starch	1 "
Water	q. s.

The mixed powders are to be made into a paste with water, and applied in a moderately thick layer to the parts to be denuded of hairs, the excess of the latter having been previously trimmed off with a pair of scissors. From time to time a small part of the surface should be examined, and when it is seen that the hair can be removed, the mass should be washed off.

The barium sulphide should be quite fresh. It can be prepared by making barium sulphate and its own weight of charcoal into a paste with linseed oil, rolling the paste into the shape of a sausage, and placing it on a bright fire to incinerate. When it has ceased to burn, and is a white hot mass, remove from the fire, cool and powder.—American Druggist.

To Drill Hard Steel.—Use turpentine instead of oil, when drilling hard steel, saw plate, etc. It will drill readily when you could not touch it with oil.

To Prevent Rust on Tools.—Use vaseline, to which a small amount of powdered gum camphor has been added; heat together over a slow fire.

Sympathetic Ink.—

Lead acetate	10	parts.
Uranium acetate	1	"
Bismuth citrate	10	"
Distilled water	1000	"

Ammonia, sugar, or acacia, of each a sufficient quantity.

Dissolve the salts in the water and carefully add ammonia until a clear solution is obtained. Then add a small quantity of sugar or acacia.

Characters written with this solution are invisible, but become visible when exposed to the vapor of sulphureted hydrogen, fading again after a few minutes. They reappear, however, when the writing is moistened with a very dilute solution of nitric acid.—Gawalowski, in Pharm. Post.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Trade in Gibraltar.—Since the beginning of the year the importations of United States produce to this market have been on a very liberal scale, especially flour, American descriptions having so far completely ruled the market, says U. S. Consul Horatio J. Sprague, of Gibraltar. Produce from other countries has not been able to compete, in consequence of the difference in cost. The supplies which arrived direct from New York during the past quarter amounted to 23,548 sacks. If the importation of cereal produce from abroad were not handicapped in Spain by heavy duties, there is no doubt that this market would become an important center for the entrance of American supplies. At the present moment the demand for flour is limited to local consumption, but some of it finds its way to the neighboring Spanish villages in the shape of bread, through the several thousands of laborers daily engaged in the extensive dock and harbor works going on at this port.

It is yet too early to be able to form any opinion regarding the standing crops in the province of Andalusia; much has, however, been sown. The bean crop does not seem to promise much.

The trade in petroleum has for some time past been in the hands of four importers, who have also been long-established retailers in the article in this market. Owing to a combination among them they succeeded in converting the business into almost a monopoly, raising prices to exorbitant figures; but a few outsiders having lately imported a small supply of the article to retail in this market, the competition has caused quite a decline in prices, which at present hardly permit of any margin.

During the past month 18,190 cases of refined petroleum were imported direct from New York, the greater portion being for account of the combination. The want of facilities for the storing and handling of petroleum on shore and afloat, added to strict police and fortress restrictions, prevent speculation to any extent.

American lard has been in fair demand during the past months, the ruling prices being considerably under the price of Spanish supplies, which have, for some time past, been quite scarce, owing to the reduced number of hogs which were raised during the last year in the south of Spain. Imports from the United States come in wooden pails, and lately 2,000 pails were received direct from New York by steamships.

The tobacco market has lately been very inactive for outward traffic, but the local consumption continues to gradually lessen the large stocks stored previous to the imposition of 1d. per pound duty last year. The direct arrivals from the United States during the present year have so far consisted of only 333 cases and 17 hogsheads of leaf tobacco, and 175 cases of Cavendish.

A very extensive business continues to be carried on in American salted pork, hams, bacon, cheese, and every kind and description of canned provisions, vegetables and fruits. These articles of daily consumption generally come through English ports, principally Liverpool, and in such quantities as to fully meet the demands, not only of this British colony and the shipping arriving at its port, but also of the Spanish neighborhood.

Heavier Rails for Siberian Railway.—A St. Petersburg dispatch to The London Times, under date of March 29, regarding the progress of the great Siberian Railway, may be of interest to the steel-rail manufacturers in the United States, says U. S. Consul Marshal Halstead, of Birmingham, England. It announces that the imperial exchequer will open a further credit of 82,770,600 rubles ($42,626,889) for improving the lines of traffic and transport of the western and central sections of the railroad. The disbursement of this large sum is divided so that 8,750,000 rubles shall be used during three years for various needs of traffic, 43,000,000 rubles during nine years for increasing the speed of trains, and 31,000,000 rubles during four years for new rails, making the aggregate amount allotted for this purpose in the current year 16,500,000 rubles ($8,497,500). This large sum is in addition to 30,500,000 rubles ($15,707,500) for the Siberian Railroad and 71,000,000 rubles ($36,565,000) for other lines in this year's estimates. The last paragraph of the dispatch reads as follows:

"The increase of the traffic on the eastern and still more on the western section of the Siberian Railway has surpassed all expectations. Its construction was originally planned on economical lines, but the pessimist forecasts of little or no movement for some years to come are being falsified by the facts. Consequently the light rails, which are only 18 pounds, instead of 24 pounds to the foot, will have to be changed. Everything was calculated for not more than three pairs of trains per twenty-four hours, whereas there are already eight pairs, besides the bi-weekly express from Moscow to Krasnovadsk. The last year's traffic returns of the western Siberian section show 350,000 passengers, nearly 490,000 tons of goods, and 400,000 peasant emigrants. Last winter, although 600 new trucks were added and 1,600 old ones borrowed, there was an accumulation of 7,000 truck loads of goods for which no means of transport could be found. Of the 490,000 tons carried over the railway in 1898, more than 320,000 tons consisted of cereals. In the course of the next five years it is expected that the carriage of wheat here will reach over 800,000 tons per annum. In the Altai mining district alone at the present moment there is a surplus of 355,000 tons of wheat, while in central Russia whole populations are suffering from actual famine."

Study of Commerce in France.—Consul Skinner writes from Marseilles, March 24, 1899: The commercial organizations of France are doing all within their power to promote the study of foreign commerce and foreign languages and to overcome the national habit of indifference to the latter. To this end the Society for the Defense of Commerce in Marseilles maintains a free commercial school, and the National Ministry of Commerce grants "purses for residence in foreign lands." Purses of the first category (4,000 francs, $772 for the first year, 3,000 francs, $579 for the second) are reserved for young men of not less than 16 and not more than 18 years who desire to establish themselves in some country beyond Europe, and who, by virtue o the law of July 15, 1889, are relieved of the obligation of active military service if they reside regularly in foreign parts until they shall have attained 30 years. The purses of the second category (varying from 2,500 to 4,000 francs, $482.50 to $772) are for young men aged not more than 26 years, graduates of a high school of commerce, who, after having accomplished their military service, are desirous of completing, by a practical apprenticeship, their theoretical knowledge gained at the school. This year two purses are to be granted for each category.

Telegraphs and Telephones in Madagascar.—In reply to a Pennsylvania correspondent Consul Gibbs writes from Tamatave, March 18, 1899:

The Morse open-circuit system is used here. The messages are received on rolls of tape, similar to the stock-quotation tickers in use on the New York and other American stock exchanges. There are about 1,200 miles of line and wire at present, and the net is being increased. The telegraph, connected with the Post Office Department, is controlled by the French government.

It is not thought possible to introduce any improved telegraph system into Madagascar, owing to climatic conditions. The present system is out of order about one-third of the time; so much so, that a bulletin as to its condition is published in the tri-weekly editions of the Journal Officiel of the island. There is a telephone used principally by the government offices. It is the Ader system. Business does not demand its general adoption by the commercial houses. I do not think conditions propitious for the successful establishment of telephone exchanges.

Any circulars relating to the introduction of enterprise into Madagascar should be in French to receive attention. Commercial and speculative transactions are conducted almost entirely in this language.

Hawaiian Commerce in 1898.—A comparison of the annual report of the collector-general of customs of these islands, for the year 1898, with that of last year is very interesting. An increase is shown in almost everything imported, and some of the gains are significant.

The decrease in the importation of gunpowder and firearms was undoubtedly caused by the islands becoming part of the United States.

Less fertilizer, by over $94,000, was imported, though the consumption increased. This is accounted for by the fact that the local works manufactured more than ever before.

Light wines decreased in value $18,656.81, due to the smaller importations of high-priced European wines. The consumption of California wines has increased 15,163 gallons during the year, the figures being 185,573, as against 170,410 last year.

The total receipts from customs were $896,975.70, as against $708,493.05, an increase of $188,482.65.

It has been stated that the merchants here have been buying goods since annexation, in anticipation of higher duties. By comparing the value of imports for the past seven years, it will be seen that the apparently large increase over the importations of 1897 is no greater in proportion than the increase of former years. I am surprised that the increase has not been greater.

Few persons who have not lived here can fully appreciate how much the general prosperity of these islands depends upon the sugar market. Excepting the transients, every one makes or loses according to the profits of the plantations. With annexation came a feeling of security of a market, and when you add to this an abnormally large crop with high prices it is not surprising that new plantations should be promoted. These plantations are capitalized for amounts varying from $1,000,000 to $3,500,000, every cent of which will be expended before anything is received from the sale of sugar. A great part of this money goes toward the purchase of machinery and supplies. Of this money I should say that 75 per cent. is spent in the United States. In round numbers, probably $25,000,000 is invested in sugar, practically all of which is owned here. The stock of these plantations is held by all classes. Every cent not needed in business goes into sugar. Those who bought sugar stock last August will be able to realize by August next 100 per cent. profit on their investment. Does it seem likely, as a prominent merchant said to me the other day, that importers would tie their money up in merchandise they did not need, with a possible chance of making a profit of 20 per cent. by the extension of our tariff, when they can make more by investing it in sugar stock? It must also be borne in mind that in this climate there is great deterioration, and merchants do not dare carry too large a stock.

The imports since 1892 are as follows:

1892	$4,684,207 31
1893	5,346,181 43
1894	5,713,181 43
1895	5,714,017 54
1896	7,164,561 40
1897	8,838,203 09
1898	11,651,890 81

The following shows the value of imports in 1898 from the countries named:

United States	$8,695,591 36
Great Britain	1,287,726 67
Germany	352,043 65
British Colonies	481,768 01
China	328,851 87
Japan	354,324 98
France	43,655 55
Pacific Islands	7,292 12
Other Countries	99,636 33

The large increase from the British colonies was coal, the greater part of which was imported by the United States for the use of the army and navy during the late war.

Of the imports, $1,282,075.72 was specie of American mintage.

The percentage of vessels by nationalities was as follows:

	Per cent.
United States	60·32
British	21·17
German	4·06
Hawaiian	13·29
All others	0·62

The exports for the year amounted to the total sum of $17,346,744.79, as against $16,021,775.19 for 1897, an increase of $1,324,969.60. The ports of Honolulu and Mahukona fell far behind 1897 exports, while Hilo and Kahului forged ahead.

The number of vessels to enter at the custom house during the year (excepting transports, naval vessels, and coasters) was 481, against 427 for 1897, an increase of 54. Of this number 209 were of American register. This is a falling off from the figures of American vessels for 1897, but is explained by the fact that a number of American steamers which made regular stops here were taken for transports last summer, and are not included in the above figures.

During the year 1898, 17,229 persons landed on the islands and 7,313 departed.

It will be seen by the above that the prosperity of these islands depends almost entirely upon their one great staple—sugar. Any cause which lowers the price of sugar will make every one here poorer. By the annexation of Hawaii the United States gained territory with a population, if we except the Asiatics, as rich per capita as one will find in any place in the world. In their present prosperous condition they are good customers of the mainland.—William Haywood, late Consul-General, Honolulu.

The Syria-Ottoman Railway.—It may interest American manufacturers to learn some particulars about this new enterprise, says United States Consul G. Bie Ravndal, of Beirut. The chief organizers of the Syria-Ottoman Railway Company are Mr. J. R. Pilling, Effingham House, Arundel Street, Strand, London, and Mr. H. Hills, of the Thames Iron Works, London. The proposed capital is $5,000,000, but no shares will be put on the market, so it is said, until the line is completed as far as Nazareth. The road will run from Haifa, a seaport town 75 miles south of Beirut, to Damascus, a distance of some 142 miles, and the project includes an extension from Damascus to Bagdad, and the Persian Gulf. While the Jaffa-Jerusalem (54 miles), the Beirut-Damascus Hauran (153 miles), and the Lebanon Tramway (10 miles) are narrow-gage concerns, the Haifa-Damascus Railway will be of standard width. It is primarily intended to tap the great Hauran wheat regions, which are only partly developed, being still under the sway of Bedouin and Druse tribes, and to afford another outlet for the growing trade of Damascus, the largest city in Asiatic Turkey. Active operations commenced last month on the division between Haifa and the Jordan, and the line is to be completed in less than two years as far as Damascus. Sir Douglas Fox (28 Victoria Street, London) is the chief engineer of the Syria-Ottoman Railway, while Dr. G. Schumacher (civil engineer and United States consular agent) is superintendent of the works at Haifa, assisted by Mr. H. T. Foord, agent of the company. The Thames Iron Works being crowded with orders, it is likely, so I am informed, that rails, locomotives and other material will be bought in the United States.

American Iron in South Africa: Trade Notes.—The following, dated Cape Town, March 13, 1899, has been received from Consul-General Stowe:

The Pittsburg Iron Company has received an order for the supply of iron piping for Johannesburg, South African Republic, which, it is estimated, will amount to $1,000,000; but, as it was secured through a London house, the iron will not appear in the imports to South Africa from the United States. This is only one of the items for which South Africa does not get credit as an importer from America.

The South African Republic has appointed consuls-general to Washington, London, Berlin, and other capitals. Vice-consuls will be placed in Rotterdam, Flushing, Antwerp, Bordeaux, Marseilles, and Genoa.

The Argentine Republic and Austria-Hungary have placed diplomatic consuls-general at Cape Town.

The recent drought in South Africa is over, soaking rains having fallen and rivers being now overflowing.

For the month of February, 1899, the imports into Cape Colony were $645,589.89, as against $605,523.99 in the same period for 1898.

The exports for February, 1899, were:

Merchandise	$170,892 01
Diamonds	169,159 54
Gold (raw)	732,290 80
Total	$1,072,342 35

In 1898 the total was $929,897.19.

Goods were entered at the ports of Cape Colony, during February, for removal to the South African Republic and other states outside the Customs Union, to the value of $157,634.67, as against $124,533.74 for February, 1898.

There were recently landed at this port from the United States 58 cows, 23 fine horses, 53 mules, and 50 merino rams. Forty-four mules are on the way for Cecil Rhodes' vineyard and 54 for general sale.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 414. May 1.—*Trade in Gibraltar—*Heavier Rails for Siberian Railway—Slaughterhouses in Paris—Axes and Dolls in Paraguay—*Study of Commerce in France—Tramways in Gothenburg.

No. 415. May 2.—New Trade-Mark Law in Japan—New Copyright Law of Japan—Patents and Trade-Marks Registered in Japan.

No. 416. May 3.—Trade in Aden—Natural vs. Artificial Indigo in the East—Tobacco and Vanilla Crops in Mexico—Educational Statistics in Russia—Gold Output of Russia—Stock in Venezuela.

No. 417. May 4.—American Wheat at Malta—Colonization in Paraguay—Electric Works in the Netherlands.

No. 418. May 5.—Wood Seasoning by Electricity—*The Syria-Ottoman Railway—Economic Conditions in Norfolk Island—Telegraphs and Telephones in Madagascar—Rice Exports to Cuba.

No. 419. May 6.—Labor Conditions in Great Britain—Automobiles in Paris—Shipbuilding in Germany.

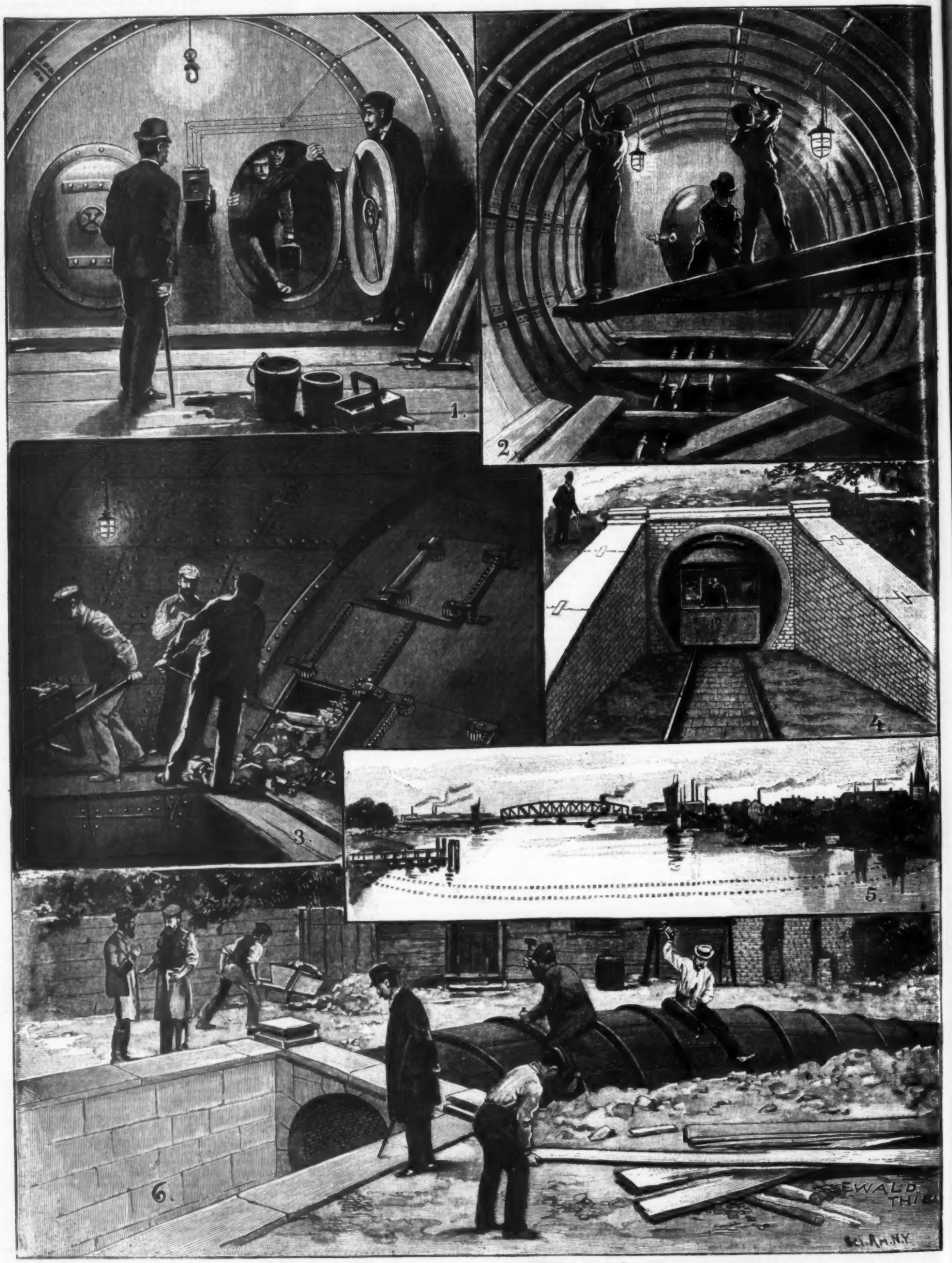
The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

THE NEW TREPTOW-STRALAU TUNNEL UNDER THE SPREE.

To such an extent has traffic increased in the city of Berlin, that the ordinary means of transit from place to place have been found inadequate to cope with the constantly increasing needs of the inhabitants. Moreover, the extension of the city limits imperatively demands the building of a road which would provide the requisite transportation facilities.

As early as 1891 the Allgemeine Electricitätsgesellschaft submitted to the city officials a plan for underground road drawn up by Baudirektor Mackensen. In carrying out this plan it seemed to the city officials that no little expense and labor would be incurred, owing to the peculiar character of the land, consisting as it does largely of quicksand. It was, therefore, decided that before granting the desired concessions, the practicability of boring through quicksands would first have to be demonstrated. It has now been proved to the satisfaction of the officials that the plan is feasible; for the company has just tunneled through the quicksands between Treptow and Stralau under the river Spree.

This railway tunnel constitutes one of the most im-



1. The lock-chamber. 2. Lining the interior with iron plates. 3. Digging and removing the earth in working-chamber. 4. The tunnel exit at Stralau. 5. The Spree between Treptow and Stralau, showing the position of the tunnel. 6. Building the last section of the tunnel at Treptow.

CONSTRUCTION OF THE NEW RAILWAY TUNNEL UNDER THE SPREE.

portant engineering works of its kind. In its entirety it is 453 meters (1485·84 feet) long, of which 200 meters (756 feet) lie under water. In the direction of Treptow to Stralau the tunnel is built on a downward incline (1:20), but becomes more level as it passes under the river (1:600). As the floor of the tunnel lies about 10·7 meters (35·10 feet) below the mean water-line of the river, a sufficiently strong roof of earth is provided before the water begins.

Owing to the fact that the bed of the Spree consists largely of the quicksands previously mentioned, and that the work had to be carried on at a considerable depth, the use of compressed air was necessary.

The entire tunnel consists of a series of iron annular sections, each 2 feet 1 inch deep, with flange-joints. These sections were placed in position by means of a new working-shield, invented by the German engineers Mackensen and Lauter. The shield was pressed forward as the work advanced, by sixteen hydraulic rams which were placed equi-distant from one another around the interior. In order to reach the working-shield it was necessary first to pass through air-locks which served the purpose of enabling the workmen to pass from a normal atmospheric pressure to the higher pressure of the working-chamber.

The shield is divided into two chambers separated by a partition. In the rear chamber the annular tunnel sections were placed in position and riveted in place; and in the front chamber fresh excavations were made, the loose earth being drawn through lock valves. Owing to the pressure in the working-chamber the water was prevented from flooding the tunnel. The loose earth was carried away by cars and water pressure, the water being led away by pipes to the tunnel entrance, thence to be pumped into the Spree.

Telephone wires were carried along the roof of the tunnel, so that those at work could communicate with the power-houses.

In Fig. 6 in the annexed illustrations the building of the last section of tunnel on the Treptow side of the river is represented. Here a walled ramp, 40 meters (131·20 feet) long was built, and the tunnel entrance closed by a door. The Stralau end of the tunnel is similarly arranged.

Disregarding minor mishaps which were unavoidable owing to the imperfect working of new machinery and the lack of experience of the laborers, no great accidents occurred during the progress of the work. Encouraged by this success, the company has submitted to the city government plans for another underground railway, which is to run north and south, and which will still further relieve the congested condition of the city's traffic.—Das Buch für Alle.

THE FOLDING MILITARY BICYCLE.

THE last great maneuvers of the French army, in which participated the bicycle company commanded by Capt. Gerard, had the result of showing definitively the value of organizing such companies as adjuncts to the divisions of cavalry. The problem of mounted infantry, which has been the order of the day in armies from the remotest antiquity, and particularly since the adoption of firearms, is, therefore, finally solved. It is, as well known, with the folding and portable bicycle devised by Capt. Gerard that tactical experiments have been carried on for four consecutive years. This machine, which we have already described, has recently undergone numerous improvements which we purpose to examine.

The frame has been strengthened by a second tube parallel with the first, thus giving the machine very great rigidity along with perfect stability. These two tubes, owing to their wide diameter (one inch), reduce the vibrations that play so considerable a part in the expenditure of force by the cyclist.

The method of folding, although it called forth no objections during the four years of experiment, has, nevertheless, been modified as a consequence of the addition of the second tube. At the center of the right hand side of the parallelogram forming the frame, there has been placed a ball joint. Each of the parallel tubes is divided in the center, and the ends, which are beveled, are held in place, when the machine is open, by coupling sockets similar to those that existed in the first model.

When the ends of the tubes are exposed by loosening the sockets and shoving them back upon rings (upon which they are held through friction), the front part of the bicycle, in revolving around the ball joint, abuts against the hind wheel. This improvement, in which the valuable features of the former method of folding are preserved, greatly facilitates the operation of opening and closing the machine, and permits of effecting it very quickly. Any looseness that may occur through the repeated foldings is immediately corrected. The system of folding is, therefore, regulatable. The joint, and consequently the bicycle, may be divided into two parts, while the handle bar may be removed from the steering head.

In order to render the folding bicycle immovable, a small brake provided with a handle has been placed upon the curved tube of the rear frame. Two revolutions of the handle press the block of the brake against the rubber tire and prevent the wheel from turning. It will be seen from this that, if the pedal to the right has been placed against the tire of the front wheel (after the two wheels have been placed side by side), it, too, will be rendered immovable, and, consequently, prevent the front wheel from revolving and separating itself from the hind one.

Upon a march, this little brake, in a long descent, may be utilized for locking the rear wheel; while in a halt, it serves for rendering the machine immovable when placed against a row of others, or against a wall, tree, sidewalk, etc. Finally, it serves also as a nail puller. In fact, if it be so arranged that the block shall just graze the tire, every nail that chances to stick into the latter will, before the wheel has made a second revolution, come into contact with the block and be extracted before it has had time to penetrate the air chamber.

Considerations that are entirely military have made it incumbent upon the cyclist to maintain a position in the saddle such that he can, at any moment, touch the ground with his feet. This is one of the primordial conditions of the existence of troops of bicyclists. It would be impossible, in fact, to conceive how such a troop, with its war complement of 200 men, could wheel over slippery roads or bad pathways did it not possess this faculty, which makes of the folding bicycle an instrument of security. Order, cohesion, and discipline in the ranks are the principal factors of the government of troops, and a troop of bicyclists cannot escape them. It must, like other branches of the service, be a unit in the hand of the chief.

It is, moreover, owing to this peculiarity of the folding bicycle and also to the ease with which the machine is carried (making of the cyclist a combatant who is never embarrassed by his steed) that the experimental company of cyclists has, wherever it has been employed, met with the success that has resulted in the formation of companies as adjuncts to the divisions of cavalry.

As the position of the cyclist in the saddle peculiar to the folding bicycle might lead to criticism, principally with regard to men of short stature, who, as a consequence of the slight height of the saddle, are obliged to pedal too obliquely, Capt. Gerard, without modifying the general form of the machine, has so jointed the rear fork of the frame that, in pivoting around a fixed point situated near the axle of the hind wheel, it may, in sliding upon the curved tube through its upper crossbrace, take any inclination that may be desired. Hence the saddle can, at the will of the rider, be made to occupy the position that it assumes in ordinary bicycles, or one that is intermediate between such position and that which is peculiar to the folding bicycle (Fig. 3). A binding collar placed near the upper crossbrace of the fork keeps the latter in the desired position. The machine thus modified may be ridden by a ten-year-old boy as easily as by a very tall man.

In order to diminish the weight of the folding bicycle, the thickness of the latter has been reduced, and the traps carried by the cyclist have been arranged as high as possible upon the handle bar. The cranks employed are from 6½ to 6¾ inches. The distance covered at one revolution is 16 feet, which, as in other bicycles, may be raised to 19½, although for troops of bicyclists it will be of interest to reduce it, since, on a campaign, conditions will naturally change.

For the above particulars and the illustrations we are indebted to La Nature.

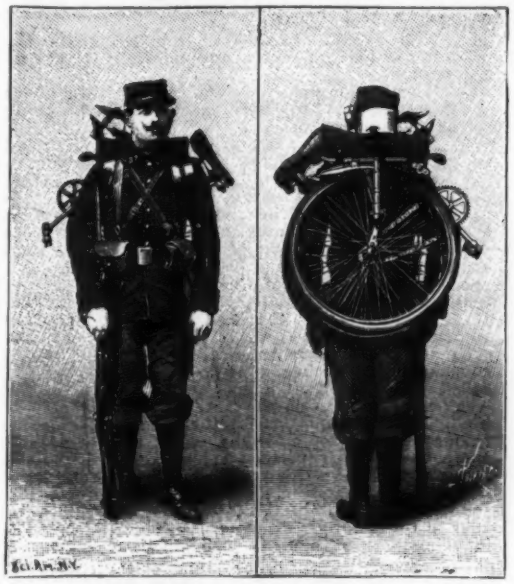


FIG. 1.—FRONT AND REAR VIEWS OF A SOLDIER CARRYING A FOLDING BICYCLE.

FIG. 2.—BICYCLE FOLDED.

FIG. 3.—FOLDING BICYCLE AND ITS REGULATABLE FRAME.

FIG. 4.—FOLDING BICYCLE OPEN.

CORRESPONDENCE.

NOTE.—We do not hold ourselves responsible for any statements or opinions advanced by our correspondents.

THE MAXIM SMOKELESS POWDER CONTROVERSY.

To the Editor of SCIENTIFIC AMERICAN SUPPLEMENT:

In your issue of the 6th instant appeared a long article signed "An English Correspondent," while in the SCIENTIFIC AMERICAN of the same date were two articles, one signed "Edmund J. Ryves" and the other "Hiram S. Maxim," dealing with the subject of the history of Smokeless Powder.

All who are familiar with the peculiar style and characteristic expressions of Mr. Hiram S. Maxim will be able to identify each of the communications as the work of the same author. Furthermore, some of the matter in each of the said articles has appeared elsewhere over Mr. Hiram S. Maxim's own signature.

As I am attacked and severely criticised in the articles, and as there are many unscientific and wholly erroneous criticisms of my article which appeared in the SCIENTIFIC AMERICAN of April 8 last, on the blowing up of the 10-inch gun at Sandy Hook, I hope that you will permit me to correct a few mistakes and to show proofs of the falsity of a few statements.

In his communication to the SCIENTIFIC AMERICAN, Mr. Hiram S. Maxim makes the following statement:

> "I have repeatedly seen letters in the SCIENTIFIC AMERICAN, New York Herald, and other journals, signed 'Hudson Maxim,' in which he claims to have worked with me in the early development of smokeless powders."

And he continues:

> "These statements are misleading in the extreme, because, as a matter of fact, Hudson Maxim had nothing whatever to do with the early development of smokeless powder in England. . . . I had two assistants, Mr. Edmund J. Ryves and Mr. Brewer. Hudson Maxim did not assist with the experiments and had nothing whatsoever to do in the invention or development of this powder."

The above statement is so plain, it cannot be misunderstood. I am glad of this, as it is a flat contradiction to many statements which he has previously circulated to the effect that I took advantage of information gained while assisting him in experiments in England in 1888, and that all the patents which I have taken on smokeless powders were based on information which I then "cribbed" from him. The reason for his shifting from that to his present position may be because it was manifestly absurd that he should have neglected to patent his most important inventions and left them for me to patent several years later, while he rushed into the Patent Offices all over the world with his castor oil patents. Many who have heard from him the earlier story will be surprised at his new version, and that he now claims I never did assist him in his early experiments, and had nothing whatsoever to do with them.

I do not wish to detract in the least from whatever favorable reputation my brother Hiram may have merited in connection with the development of smokeless powder; but as he has undertaken to magnify the importance of his own work at my expense, and to belittle what has been done by me, with utter disregard of the actual facts in the case; and as he has volunteered to give the public his own distorted version of the secret history of smokeless powder, it becomes my duty to tell the true story and to support it with unimpeachable evidence.

In 1888 I spent four months in England, returning to America on the 9th of December, under a two years engagement with the Maxim-Nordenfelt Guns and Ammunition Company, Limited, as their representative for the sale of guns. Nothing was mentioned in the contract about anything which I might invent. My duties ended with the commercial representation of their interests. My inventions were my own.

During my four months in England, there was great excitement about the wonderful results obtained by a smokeless powder made and kept secret by the French government.

Everybody was anxious to find out what the secret was and many were the guesses. One evening, while out walking in Bexley, with my brother Hiram, I told him I thought the French powder was probably one of two things—either guncotton made into paper, then well "sized" and calendered very hard and cut up into laminæ, or it was guncotton dissolved and dried in sheets and then cut up into grains. I suggested as a "size" or filling material for the paper, the use of the usual materials, gums, resins, etc., or egg-albumen, usually employed in paper manufacture, and also collodion. He believed that the second of my guesses was correct and that the French powder was probably a hard substance formed by dissolving and drying guncotton.

Within the next few days, Hiram visited the Continent on some business in connection with the Maxim gun. During his absence, I was given a few grains of the French powder by one of the employes of the Maxim-Nordenfelt Company, who had been in Paris in connection with Maxim gun experiments. On my brother's return, I showed him my find. He was fairly beside himself with delight, and remarked that he would not take ten thousand dollars for those few grains. We tried one of the grains in ether and alcohol, but found it would not dissolve. We then tried acetone, in which it dissolved very readily, forming the sirupy fluid characteristic of tri-nitrocellulose solutions.

We then dissolved a small quantity of guncotton or tri-nitrocellulose, which we dried and placed alongside the dried solution of the French powder grain. We then cut off, or trimmed straight, one side of each, and placed them together on a pane of glass, and examined the two films under polarized light, and saw that they were both the same substance—tri-nitrocellulose.

In a letter to Sir Andrew Nobel, written on the 15th of November, 1895, referring to the important assistance which I had rendered him in those early experiments, Mr. Hiram S. Maxim made the following statement:

> "Of course, I took a great many patents. The amount of experimenting I did was very great. At the time of making these experiments my brother Hudson Maxim was in England and assisted me. We found that by the addition of nitroglycerin we could obtain higher ballistic results, but we did not believe it would be safe to employ more than 25 per cent."

When he wrote the above, he had, however, doubtless forgotten the fact that no experiments had been conducted with nitroglycerin and that the use of nitroglycerin in smokeless powders had not been thought of by either of us until after I returned to America on the 9th of December, 1888.

In proof of this I beg to quote the following paragraph from a letter received from Mr. Hiram S. Maxim, dated September 11, 1889:

> "Mr. Symon has received from Mr. Adams the letter which you sent Adams referring to your inventions.
>
> "Mr. Symon was very much 'up on his ear' about it, stating that they were exactly the same thing as we had ourselves.
>
> "I told him that at the time you were in England we had not used nitroglycerin and that you, as far as I knew, had found it out yourself in America, and had offered it to us as a good thing."

However, in spite of the above acknowledgment on the part of Hiram, when he has since wished to have it appear that his compound of nitroglycerin with guncotton dated back as far as possible, he has told that I got my ideas of the use of nitroglycerin from him, and that my first United States patent on explosives, No. 411,127, September 17, 1889, was based on information gained from him while I was in England.

Upon my arrival in America, in December, 1888, I continued my experiments with smokeless powders. I called upon Mr. Emil Kipper, the president of the American Zylonite Company, Adams, Mass., and was kindly shown by him through their works. He also introduced me to Prof. Mowbray, one of the chemists of the company, an expert on explosives, who was the first man to make nitroglycerin on a commercial scale in the United States, in connection with the work on the Hoosac Tunnel. I was introduced by Prof. Mowbray to Dr. Schüpphaus, the other chemist of the company, and who has since become famous in connection with smokeless powder. Accompanied by Dr. Schüpphaus, I visited the old nitroglycerin works of Prof. Mowbray, on Hoosac Mountain, and secured about a quart of nitroglycerin which had been made there seven years before. I brought a small quantity of high grade guncotton with me from England. I secured some celluloid pyroxylin or soluble guncotton, called mononitro-cellulose, from the Zylonite Company. I also obtained some concentrated acids from the Zylonite Company, and made small quantities of both guncotton and nitroglycerin. I made compounds of guncotton and nitroglycerin of varying percentages. I wrote to my brother in England, telling him what I had done.

My experiments with compounds of guncotton and nitroglycerin probably antedated those of Mr. Hiram S. Maxim.

At this time, Prof. Mowbray informed me that they had long experimented with the use of castor oil in celluloid compounds, and he advised its use in smokeless powders. This information I communicated to my brother Hiram. This may throw some light on the castor oil matter.

I also secured an option from Prof. Mowbray for a process which he had invented for making tri-nitrocellulose. My own inventions, together with the Mowbray option, I offered to the Maxim-Nordenfelt Company. Soon after that I received a communication from my brother dated Crayford, August 8, 1889, in which he stated:

> "There is nothing new about the addition [of nitroglycerin to a solution of guncotton. It was patented fifteen years ago by Nobel."

Compare this with Mr. Hiram S. Maxim's present claim that he was the first to compound nitroglycerin with guncotton.

However, after the issuance of my first patent, I was recalled to England by the company, and there was much bitterness of feeling on the part of some of its members for my having applied for patents in America on my own account. On my arrival in England I had a conference with the full board of directors. I offered them all I had done on terms perfectly satisfactory to them, and they were to take the necessary steps to prosecute the business in America and carry out the Mowbray option. I returned to America in about three weeks with my salary doubled. They were to organize an American company, both to make smokeless powder and manufacture Maxim guns, and I was to have fifteen per cent. of the share capital of the company, with a five years' contract with the company at $5,000 a year and expenses, to be entered into as soon as it was brought out. The company was not organized, and neither the option with Prof. Mowbray nor myself carried out. Consequently, according to the terms of the contract, all my inventions reverted to me.

However, I again visited England and entered into a new contract with the Maxim-Nordenfelt Company, giving them an option of six months to organize an American company to work my inventions. They paid $5,000 for the option. The proposed company was to be organized with a cash working capital of $88,000 to make smokeless powder. My brother Hiram and Mr. Symon returned to America with me in connection with this business.

But this company was not organized, and the matter fell through.

I then went into business for myself in America, raised the capital for a dynamite factory, and also for a small smokeless powder plant at a small place in New Jersey, since named "Maxim" in my honor.

In 1893 Dr. Robert C. Schüpphaus associated himself with me. We pooled our inventions and have been collaborators ever since. After the Maxim-Schüpphaus smokeless powder had been most exhaustively experimented with by the United States government, and proved superior in every respect to all powders which had been produced, I again returned to England and offered all my inventions and those of Dr. Schüpphaus for the whole world to Maxim-Nordenfelt Company; and I furthermore offered my brother fifty per cent. of all that might be netted from the sale of the inventions, provided he would not oppose me, but assist me in their negotiation and sale should they be sold within five years by means of or in conjunction with his assistance. He signed a contract with me to this effect.

The Maxim-Nordenfelt Company ordered some of the powder for experiments in England. However, after the powder was made, the company refused to accept it unless I should agree to certain new and impossible conditions which they proposed, relating to the agreement between us. Consequently the matter fell through.

Hiram now states that the reason for the non-shipment of the powder to England and its non-acceptance by his company was because it would not stand the British government stability test, and consequently could not be admitted into the country.

Last year I sold to Sir William Armstrong, Whitworth & Company 800 pounds of Maxim-Schüpphaus smokeless powder. They encountered no such difficulty.

A sample of the Maxim-Schüpphaus smokeless powder was tested by Mr. Hiram S. Maxim himself, and in a letter addressed to Lieut. J. F. Meigs, engineer of ordnance, Bethlehem Iron Works, Bethlehem, Pa., dated 32 Victoria Street, London, S. W., August 8, 1895, in referring to the test of the powder made by him, Hiram S. Maxim stated:

> "I have tested some of it with the apparatus and in the manner employed by Prof. Abel. A powder should stand this heat test for fifteen minutes; the new powder stood it for thirty minutes."

In the article referred to, signed "Edmund J. Ryves," it is stated that some Chilworth cordite was transversely perforated according to one of my patents and tested in his presence, with very unsatisfactory results. The Chilworth cords which were used for that test were too small for any advantage to be derived by transverse perforations. I had recommended that some rectangular bars of cordite material be made about an inch in diameter and from an inch and a half to two inches wide, and transversely perforated with rectangular holes. Instead of being made thus, the largest rods were only seven-sixteenths of an inch in diameter and were round. Not only this, but the larger rods were very faulty, having cracked very badly in drying, so that they were cut throughout with small seams and fissures, which, being tapped by the transverse holes, presented an enormous initial area and consequent high pressure.

The reason why the negotiations with the Maxim-Nordenfelt Company fell through was not owing to any fault of the Maxim-Schüpphaus smokeless powder, but it was because the directors of that company had got the impression from Mr. Hiram S. Maxim that all the essential features of the Maxim-Schüpphaus powder were originally "cribbed" from him while I was in the employ of that company. The directors, therefore, naturally felt that the company should not be required to pay much of anything for the inventions.

Notwithstanding Hiram wrote many letters in connection with negotiations between myself and other parties, in which he spoke of the powder in the highest terms and of the importance of my inventions in connection therewith; yet he was always careful to make it appear that the Maxim-Schüpphaus powder was merely an improvement on the original "Maxim" powder invented by him.

The following letter from Dr. Robert C. Schüpphaus will throw considerable light upon this matter:

LETTER FROM ROBERT C. SCHÜPPHAUS, PH.D.

"Charlottenburg, Germany,
"September 17, 1898.

"Hudson Maxim, Esq., New York City.

"Dear Sir: Your letter of August 30 was received, telling me of the statements made by Mr. Hiram S. Maxim about smokeless powders, and his claims to being the inventor of important methods and processes, and his further assertion that many of the important features of the Maxim-Schüpphaus smokeless powder originated with him and were taken from him.

"I have been long aware that he was making some such claims. In fact, in the fall of 1896 I was told in London by Mr. Albert Vickers that he had understood from Mr. Hiram S. Maxim that all the important methods employed by us were taken from him and that they were his inventions. Mr. Hiram S. Maxim was forced to acknowledge before Mr. Albert Vickers in my presence that any such conclusion in regard to the Maxim-Schüpphaus powder as Mr. Vickers might have arrived at through remarks of his was false, and that not a single feature of this powder originated with him. I have in my possession a letter addressed to me and signed by Mr. Albert Vickers for Vickers, Sons & Company, Limited, dated London, November 2, 1896, which closes as follows:

"'We undertake not to manufacture this powder without having made an arrangement satisfactory to yourself.'

"Anybody who is familiar with the history of smokeless powder and the actual processes of manufacturing these powders knows that none of Mr. Hiram S. Maxim's inventions is being used today in the commercial production of any smokeless powder in the world.

"You may give any publicity you wish to this letter, in order to meet the unfounded claims made by Mr. Hiram S. Maxim and also to show that, as we stood together and shared the work and the trials in the production of the Maxim-Schüpphaus smokeless powder, there is now no disposition on the part of either of us to rob the other of the full measure of credit deserved, and we stand together in sharing the credit as we did in sharing the work.

"Sincerely yours,
(Signed) "ROBERT C. SCHÜPPHAUS."

In recent articles published by Hiram S. Maxim, and in the said articles which appeared in the SCIENTIFIC AMERICAN and SUPPLEMENT on the 6th instant, the Maxim-Schüpphaus smokeless powder is very heartily condemned. The powder is claimed to be unstable, the multi-perforations a disadvantage and dangerous, causing great variations in velocities and pressures, and I am accused of having claimed that I assisted Hiram S. Maxim in his early experiments, and this latter is declared to be false and misleading in the extreme.

In refutation of the above statements I can do no better than to quote here a few paragraphs from the letter written to Lieut. J. F. Meigs, by Hiram S. Maxim, already referred to, a copy of which letter I have over Mr. Hiram S. Maxim's own signature. This letter will also confirm remarks hereinbefore made concerning the French powder.

"My brother Hudson was the first man outside of France to obtain an authentic specimen of the original French smokeless powder, and he assisted me in my experiments for several months. On his return to the United States he continued his experiments, and when his engagement with our company terminated, he obtained the services of Dr. Schüpphaus, a German chemist, who made a specialty of nitro-compounds, and who is regarded today as the best authority on these points to be found in the United States. Dr. Schüpphaus and my brother started out with a view of making a smokeless powder which might be considered a true celluloid, that is, a substance which would have all the hardness, density and keeping qualities of common celluloid, and should at the same time produce high ballistic results."

And referring to the Maxim-Schüpphaus smokeless powder, he continued:

"This new form of powder has multiple perforations. If powder is only perforated with a single hole it burns from the outside and the inside at the same time, but as the outside is much larger than the inside it is found that the surface on which the flame is burning is very rapidly diminished, so that the pressure falls off very quickly as the projectile moves forward in the bore of the gun. The projectile, of course, is always traveling with an accelerated velocity; consequently, it is necessary to have some powder in which the surface actually exposed to the flame is increasing rather than diminishing, so as, in a measure, to keep up the pressure as much as possible in the gun. These multiple perforations lend themselves admirably to this purpose. With the ordinary English cordite one would get about 2,000 feet muzzle velocity in a 45-pounder, with a pressure of 15 tons to the square inch. With the original Maxim powder with a single perforation, about 2,200 feet would be obtained with the same pressure, but with the multiple perforations in the new form of powder a velocity of 2,400 feet has been obtained in a 45 pounder, with a pressure of only 13·6 tons to the square inch. Moreover, it has been found that with this new and extremely hard powder, with multiple perforations, the uniformity in velocities is very great. With a soft and semi-plastic powder in long rods, like the British cordite, it sometimes occurs that the explosion produces a wave action, driving the soft and plastic powder, while still burning, into the forward end of the chamber of the gun. . . . .

"We regard this new product as being an ideal smokeless powder. I have tested some of it with the apparatus and in the manner employed by Prof. Abel. A powder should stand this heat test for 15 minutes; the new powder stood it for 30 minutes. . . . . This powder is at present made in a small factory at a little place called Maxim in New Jersey. . . . . The company there are quite prepared to put up a plant necessary to execute all orders, but as we shall probably erect the first large factory here, I see no reason why you should not obtain your first supply from England, and I feel confident that you will be able to beat every existing powder. If you obtain, for instance, a muzzle velocity of 2,200 feet with your guns with a pressure not greater than 14½ tons to the square inch with a powder that has splendid keeping qualities, I do not think the government, after that, would accept a powder which produced very much less velocities with a pressure perhaps half a ton greater. If you require powder which contains more nitroglycerin than the present powder, namely 9 per cent., we shall be prepared to make it for you, but everything considered, the 9 per cent. is best. It certainly will wear out your gun much less than if you use one containing a large percentage of nitroglycerin. "Yours truly,

(Signed) "HIRAM S. MAXIM."

Mr. Hiram S. Maxim wrote similar letters to Sir Andrew Nobel, Messrs. Pigou, Wilks & Laurence and the New Explosives Company and others, concerning the Maxim-Schüpphaus smokeless powder and the important assistance which I rendered him in his early experiments in England. The parties to whom these letters were addressed probably have them on file where they can refer to them if they do not recall the exact statements.

In my article on the blowing up of the 10-inch gun at Sandy Hook, which appeared in the SCIENTIFIC AMERICAN of April 8, I pointed out that when a powder charge is ignited at the rear, dangerous pressures are sometimes caused by the powder charge being thrown violently forward into the contracted neck of the powder chamber. This conclusion is ridiculed and illustrations are shown with an attempt to make the criticisms plausible in one of the said articles in the SCIENTIFIC AMERICAN of the 6th instant. The reasonableness of my conclusion, however, I think will be manifest by referring to the illustrations presented by me in the SCIENTIFIC AMERICAN of the 13th instant. In this connection, the following statement of Mr. Hiram S. Maxim in the above letter to Lieut. Meigs will be interesting:

"With soft and plastic powder in long rods, like British cordite, it sometimes occurs that the explosion produces a wave action, driving the soft and plastic powder, while still burning, into the forward end of the chamber of the gun."

Mr. Hiram S. Maxim was not the first man to combine tri-nitrocellulose, that is to say, guncotton, and nitroglycerin, either with or without oils. Nobel, in 1875, patented the compound of nitroglycerin and guncotton. In that patent he mentioned the employment of guncottons of different grades of solubility, and pointed out that when guncotton insoluble in nitroglycerin was employed, acetone, which is a solvent of tri-nitrocellulose, could be used in connection with the nitroglycerin. In Nobel's British patent, No. 4,179 of 1875, he entered very minutely into the details of the manufacture of his nitroglycerin-guncotton compound, and recommended the use of various deterrents for lessening the sensitiveness to detonation, among which were "fatty matters and other analogous substances." He also recommended that when his compound should be employed for "military purposes," a considerable quantity of the grease or fatty matters should be used.

It will be seen further on that Mr. Hiram S. Maxim has referred to this Nobel patent as a reference to one of my United States patents, and to prove that there was nothing new in compounding nitroglycerin and guncotton.

There is some very strong evidence that Mr. Hiram S. Maxim was not the first man in England to make smokeless powder from a compound of nitroglycerin and tri-nitrocellulose, and that Messrs. Abel and Dewar had been experimenting with compounds of tri-nitrocellulose and nitroglycerin for some time prior to nitroglycerin having been employed by Hiram S. Maxim in smokeless powder.

It is true, however, that Hiram S. Maxim rushed into the Patent Office ahead of Messrs. Abel and Dewar, and lodged his provisional application about fourteen days in advance of theirs. Now, as it is Mr. Hiram S. Maxim's method to apply for a patent immediately upon being struck with an idea, often even before he tries an experiment, it is probable that he did not think or learn of the use of nitroglycerin with tri-nitrocellulose more than forty-eight hours prior to his application for letters patent.

Anyone who knows how the government work of Messrs. Abel and Dewar must have been conducted, and the long line of careful experimentations which must have preceded their application for letters patent, will be impressed with a strong conviction that their work antedated that of Mr. Hiram S. Maxim by a very considerable period.

Mr. Hiram S. Maxim has no United States patent on smokeless powder, which is now being used by anyone, and nothing ever invented by him in smokeless powder is now being made commercially anywhere in the world. If his compounding nitroglycerin with tri-nitrocellulose was such an important and novel thing, why did he not get a United States patent on that compound? His statement in his letter to me in August, 1889, shows that he did not consider anything new in his powder except the castor oil. Could he have secured a valid claim for a compound of nitroglycerin and guncotton, and which he was entitled to if it were novel, nobody could use that compound for smokeless powder without infringing his patent, whether they were to use any oils or not.

Furthermore, why did he not claim broadly any substance as a deterrent or slowing agent? The reason was that the use of oils and "fatty matters" broadly was old, and it was necessary to limit his claims to "castor oil or equivalent oils."

In the letter of Mr. Hiram S. Maxim in the SCIENTIFIC AMERICAN of May 6, he states that an examination of the patents will show who the patentee really was, and he gives the dates, without the numbers, of his two British patents, November 8, 1888, and March 14, 1889. I will also state that an examination of the patents will show which of us, Hiram S. Maxim or myself, is the inventor of the most important inventions now used in the commercial manufacture of smokeless powders. The following is a list, with numbers and dates, of my British smokeless powder patents taken to date: No. 18,682 of 1894; No. 8,569 of 1895; No. 11,299 of 1895; No. 16,311 of 1895; No. 16,861 of 1895; No. 16,862 of 1895; No. 16,858 of 1896; No. 15,499 of 1897; No. 7,178 of 1897.

In the article signed "Edmund J. Ryves" appears the following paragraphs:

"I have thought that the American public must be very much puzzled in regard to the early history of smokeless powder and as to who the inventor really was. I have seen several articles, some in the SCIENTIFIC AMERICAN, written by Hudson Maxim, in one of which he speaks of the experiments in England, which were really made by his brother, in such a manner as to lead the public to believe that he assisted in these experiments. . . . I can say, however, from my own personal experience, that the facts of the case are as follows:

"Mr. Hiram S. Maxim first commenced his experiments at the little laboratory at his own house with his coachman as his assistant. . . . Hudson Maxim took no part whatsoever in the experiments and had nothing to do with the invention or development of the powder."

When Mr. Ryves signed that article, he was probably not aware of the fact that Mr. Hiram S. Maxim had put himself on record in numerous letters, admitting the truth that I did assist him with those experiments.

The article which he has signed must put him in a very peculiar light in the eyes of the numerous persons still in the employ of the company and elsewhere who knew of my connection with the work, and I trust that they who have read that article and will read this may not forget these facts when hearing other stories circulated about me by my brother Hiram and his allies.

In the said article, in referring to the blowing up of the 10-inch gun at Sandy Hook, the conclusion is reached that—

"It was due to one of three things, namely:

"1. The leaving out of the castor oil or vaseline from the mixture.

"2. The addition of a considerable quantity of unstable di-nitrocellulose to the compound to make it hard.

"3. The multiple perforations."

We learn in one place that "the powder patented by Hudson Maxim and Dr. Schüpphaus substitutes urea for castor oil, and in order to produce great hardness;" and in another place we learn that di-nitrocellulose is added to make the powder hard. In what way urea can be a substitute for castor oil, or how it can produce great hardness, is something which staggers me and will come to Dr. Schüpphaus as a revelation.

Di-nitrocellulose is not added to make the material hard, but for an entirely different purpose, now too well known in the art to need explanation here, while the use of urea, as is well known in the art, is as a neutralizer, and for no other purpose.

An article by Mr. Hiram S. Maxim appeared in the February number of The North American Review, which was referred to as throwing much light on the history of smokeless powder, in the last issue of the SCIENTIFIC AMERICAN SUPPLEMENT, in an article signed "An English Correspondent," and as it contains many mistakes which are repeated in the article signed "Edmund J. Ryves," in connection with the blowing up of the 10-inch gun at Sandy Hook, I will make a short quotation from The North American Review article, and will correct some of the mistakes.

In the paragraph at the bottom of page 148, and on the following page, Mr. Hiram S. Maxim states:

"The first smokeless powder that I made in England was made in exactly the same manner as the French. I had obtained a quantity of true guncotton, that is, tri-nitrocellulose (known sometimes as insoluble guncotton because it cannot be dissolved in alcohol and ether like collodion cotton, di-nitrocellulose). Some of this powder, when freshly made, produced fairly good results, quite as good as those produced by the French powder, but upon keeping it for a few months the grains lost their transparency, became quite opaque and fibrous, and it then burned with great violence. Investigation showed that about one to two per cent. of the solvent was still in the powder when the first tests were made, whereas the drying out of this last trace of solvent had completely changed the character of the powder. I then added to this powder about two per cent. of castor oil, with the result that the castor oil remained after the solvent had been completely removed, so that the powder would keep any length of time; indeed, powder made at that time (1889) is quite good to-day.

"But I wished to produce still higher results. I knew nothing of what other experimenters were doing, but it occurred to me that it would be very curious if two violent explosives like nitroglycerin and guncotton could have the same amplitude of molecular waves passing through them when the explosion took place. It also occurred to me that if the two substances were intimately combined, made into a liquid and mixed together and then dried, it might be found impossible for a molecular wave to pass through both of them. For instance, if we should take a plate of ice two inches thick and put it into a glass box four inches thick, the light would pass through both the ice and the two inches of air space; but if we ground the ice very fine so that it filled the whole space, i. e., the ice and air being thoroughly mixed together, as in light snow, a wave of light would not pass through the two; in fact, the mixture would completely shut out the light, giving a black shadow. I believed that if the nitroglycerin and the guncotton were intimately combined, an explosive wave would not pass through the mixture, and experiments revealed that I was quite correct. All mixtures of from one per cent. to seventy-five per cent. of nitroglycerin were experimented with, the result being that from ten to fifteen per cent. was found to be the best, everything considered. If larger percentages of nitroglycerin were employed, there was little liability of detonating when new, but it was found that the nitroglycerin would gradually ooze out, or one might say, evaporate out, and condense in the cartridge case, forming pools, and a very little free nitroglycerin was quite sufficient to set off the whole of the charge."

Now the above statements are peculiarly unscientific and erroneous in many particulars. In the first place, when tri-nitrocellulose is dissolved and dried, the hard colloid formed does not "become fibrous," and after the evaporation of the solvent to perfect dryness, the compound burns slower instead of faster. Castor oil has no effect to render smokeless powder more stable. It is not a preservative or neutralizer. It was first employed by Hiram S. Maxim to make the compound burn more slowly, and to prevent detonation, before it was known that such a compound was so hard that it burned too slowly instead of too rapidly; the facts in the case being that the hard guncotton colloid burns so slowly that a sufficient thickness cannot be consumed to permit of such coarse granulation as will adapt the powder for use in large guns.

The best of all softening agents is nitroglycerin. The reason why such a large percentage of nitroglycerin is used in cordite, is to enable the employment of large rods of the material, so as to present the minimum of surface to the flame of ignition. Cordite is the only compound which can be used in large guns without multi-perforations. As Mr. Hiram S. Maxim pronounces against cordite and against multi-perforations he leaves no alternative but to entirely abandon the use of smokeless powder. Of course, there is ballistite, but then that contains about the same nitroglycerin as cordite, and di-nitrocellulose enters into its composition, all of which are condemned by Mr. Hiram S. Maxim. The French use nitrate of barium, but such a powder is not smokeless.

In regard to his statement that "It would be very curious if two violent explosives like nitroglycerin and guncotton could have the same amplitude of molecular waves passing through them when the explosion took place," it is not exactly in accord with his views on the susceptibility of cordite to detonation. He doubtless also forgets that nitrogelatin, the most powerful commercial explosive known, is a compound of nitroglycerin and guncotton.

Again, he states that if larger percentages than 15 per cent. of nitroglycerin are used, it was found that the nitroglycerin would gradually ooze out, "forming pools of nitroglycerin." Anyone who has ever seen a piece of smokeless powder containing even as large a percentage of nitroglycerin as 25 per cent., and much more, is aware that no such oozing out is possible.

SUMMARY.

When Mr. Hiram S. Maxim has thought it to suit his purpose, he has told that I assisted him in his experiments in England. When he has thought it an advantage to make a statement exactly to the contrary, he has done so. Upon occasion, he has credited me with having invented a few things in connection with smokeless powders. At other times he has said that everything that I have patented originated with him, and that I came by the ideas while assisting him in his early experiments, and that many of the features of the Maxim-Schüpphaus powder were his inventions.

Mr. Hiram S. Maxim claims that the Maxim-Schüpphaus smokeless powder is simply a powder originally

invented by him, with the castor oil left out, and urea substituted for it to make the material hard, and that collodion guncotton is also employed for making the material hard and more like celluloid, while the multi-perforations he claims to be a very bad thing for the powder.

These are curious statements in view of the facts known to all skilled in the art that urea is used simply as a neutralizer, and has no influence to make the powder dark, and that collodion cotton is not employed, but a very different variety no more resembling collodion cotton than does tri-nitrocellulose. And this material is not unstable, as claimed by him, but is as stable as the tri-nitrocellulose, while neither of these ingredients could have been added to harden a compound of guncotton with a low percentage of nitroglycerin to make it more like celluloid, for celluloid is a comparatively soft substance and is nothing like as hard as the material which he claims we sought to make hard like celluloid.

Mr. Hiram S. Maxim claims he discovered that a compound of guncotton and nitroglycerin could not be detonated. He makes the above claim in face of the fact that one of such compounds, nitrogelatin, is one of the most powerful detonating substances known, and in face of his own statement that cordite will detonate, and that even the Maxim-Schüpphaus smokeless powder, with the castor oil left out detonated in the 10-inch gun at Sandy Hook, notwithstanding it only contained nine per cent. of nitroglycerin.

He claims that he was experimenting with nitroglycerin and guncotton compounds in his early experiments before I left England. He also admits, in another place, that nitroglycerin was not experimented with by him until after I returned to America, and that I thought of its use independently of him.

He claims that a smokeless powder charge, while on fire, cannot be thrown forward in the powder chamber of the gun with the results claimed by me. As opposed to this, he wrote Lieut. Meigs that such results were frequently produced with cordite.

Not one feature in the Maxim-Schüpphaus smokeless powder was invented by Hiram S. Maxim. A simple compound of nitroglycerin and guncotton was not new when either of us took up the subject of smokeless powders. This, according to Mr. Hiram S. Maxim's own words, was invented by Nobel fifteen years before. The employment of castor oil in pyroxylin compounds was invented by Prof. Geo. M. Mowbray, North Adams, Mass., at least ten years before Hiram S. Maxim filed his castor oil patent. What did Hiram S. Maxim ever invent in smokeless powders?

If Hiram S. Maxim ever invented anything very essential, it could hardly be ignored entirely in present smokeless powder manufacture. If he did not invent anything of sufficient value to compel manufacturers to use it, and something else would do as well or better, then his invention could not have been very important. The writer would be very glad of any information which will lead to the discovery of one single invention of Hiram S. Maxim which is now being used commercially in the manufacture of smokeless powder anywhere in the world. HUDSON MAXIM.

New York City, May 10, 1899.

SECRET HISTORY OF SMOKELESS POWDER.

To the Editor of SCIENTIFIC AMERICAN SUPPLEMENT:

Your issue of May 6 contains an article entitled "The Secret History of Smokeless Powder." After describing the work done by Hiram S. Maxim, the Schüpphaus-Maxim powder is reverted to in words that leave the idea that this well known American powder was built upon foundations supplied by utilization of Hiram Maxim's experience and knowledge. From other matter that has appeared it is implied that this came about by the fact that Hudson Maxim was connected with his brother in early experiments and brought to the United States in 1890 samples for tests in the small-bore rifle. At present the dove of peace is not prominent in the relations of these brothers.

There are certain facts that should be put before your readers. Having been closely connected with the development and manufacture of Schüpphaus-Maxim multi-perforated powder up to the time when it was purchased by the Dupont Company, I feel warranted in stating them. That the idea of the powder in question is traceable to Hiram Maxim is disproved by the fact that to Dr. R. C. Schüpphaus alone does the credit belong for the formula employed. Having undertaken to develop a torpedo gun system, Hudson Maxim solicited Dr. Schüpphaus to enter into an experimental partnership with him and to take charge of the powder end. This was warranted by the wide knowledge, large experience, and natural abilities of Dr. Schüpphaus. In 1890 he had brought previous study and experiments to practical application by furnishing first-class guncotton and nitroglycerin powders for trial in the 0·30 caliber rifle and by submitting a satisfactory nitroglycerin powder for the 8-inch rifle. The demand in 1894 was for something better than existed. Multi-perforated powder was agreed upon between both men. Experiments on known lines gave failures, the cordite type of powder proving the most ill adapted for the purpose in our general investigations of the properties of all the general types of powders. Dr. Schüpphaus worked on entirely new lines, discovering a formula capable of wide variation and possessing a property, unknown before, that permitted the commercial production of perfect multi-perforated powder of the most intricate cross section. In the United States it is necessary that the inventor only should apply for a patent. The American application for the formula and process of manufacture of same into multi-perforated grains stands in the name of Dr. Robert C. Schüpphaus.

Let us examine the matter somewhat technically. The patent of Hiram S. Maxim is for military guncotton, nitroglycerin, and an oil like castor oil in proportions as experience dictates. My experience has been that military guncotton and nitroglycerin in various proportions when colloidized by a solvent and formed into rods will not act satisfactorily. They warp badly upon drying, and would be dangerous and erratic in guns. The introduction of castor oil (or vaselin) obviates this to a degree and makes possible solid grains for large guns. I have, however, seen samples at Sandy Hook of cordite, accompanying a 4·72-inch Armstrong rifle, that were badly warped. The chemical action of oils will be that of a deterrent. Without disputing the claim that the combination of military guncotton and nitroglycerin when perfectly dried is liable to detonation without the presence of castor oil, this substance would also reduce the temperature of combustion. The Schüpphaus powder is a mixture of military guncotton, soluble guncotton of suitable strength and stability for powder purposes, nitroglycerin, and urea. This mixture of guncotton is employed in combination with a process of manufacture (based upon the softening property of the mixture within limits under heat discovered by him) to produce grains that are exactly the form for which the die is designed and that dry without warping or checking. The nitroglycerin percentage is varied at pleasure. The urea plays the part of a neutralizer and has not the objections of the metallic carbonates often employed. Where any resemblance can be traced between these two powders is beyond my comprehension. The Hiram Maxim formula is just as unsuited for the purpose as the other is suited. But the vagueness of the ideas of the writer of the article in question is indicated by his considering that a deterrent like castor oil and a neutralizer like urea have similar functions in a powder. Castor oil is essential to the one; urea may be omitted from the other and, in fact, was used in a one per cent. proportion to satisfy a general, though debatable, custom. Following the trend of argument of the English correspondent, I will give a concrete example of its peculiarity. "X brought out steel for armor purposes when he learned that wrought iron was being used for that purpose. Later on Y put some nickel into the steel, forged it down in heavy rolls, and then hardened its face by a special process. Clearly Y is indebted to X."

Mention is made of a series of tests in England relative to multi-perforated powder proving it was a dangerous article. I have submitted to the SCIENTIFIC AMERICAN a letter dealing with that point which may be summarized as follows: An experience of four years, during which the powder was tried in all the guns of the United States army under various conditions and was tested severely in all directions, revealed strongly its reliability, uniformity, safeness, high ballistic and low erosive qualities, and stability. Had multi-perforation per se been a dangerous condition, it would have manifested itself in that time. The English experiments, however, were a botched lot dealing with something else. We used a longitudinally perforated grain of short length. There they tried a new thing. Long rods of soft powder were punched transversely. Theory reveals little advantage of such powders. Everything was conducive to bad results. Were "English Correspondent" to lay down deductions based upon tests of a new engine in which the indicator was rusty and battered and the indicator rig wrong in its reducing motion, he would not certainly expect much consideration for his statements. Those who are familiar with the multi-perforated powder question will accord less value to his opinions on that matter. FRED. H. MCGAHIE, M.E.

New York City, May 6, 1899.

BED OF NAPOLEON I.

THE TAPESTRY AND FURNITURE INDUSTRIES UNDER NAPOLEON I.

IN 1793, Marat, in his "Ami du Peuple," attacked the Gobelins manufactory with such violence that it came near being suppressed. Nevertheless, it was kept in operation, although with some difficulty.

It was the object of the idiotic measures of a few exalted Jacobins, who, in the tapestries decorated with the emblems of royalty, saw the loss of the Republic! And, alas! there was a superintendent named Belle, who was fanatical enough to burn, solemnly and publicly, some tapestries that were considered as "reactionary." In this way there were lost very many superb works of the time of Louis XIV.

It is due to the First Consul that was saved from total ruin an establishment that has always done the greatest honor to France. The manufactory resumed its activity and glorious traditions as long ago as 1800. Guillaumot had succeeded Belle, very appreciable improvements were introduced into the manufacture, and the painters Vincent, Vien, Menageot, Le Barbier, Lagrenée, Doyen, Regnault, Lemonnier, and David presided over the production of the tapestries. The painters then in esteem were Gérard, Girodet, Isabey, Gros, and Prudhon, and the favorite sculptors were Houdon, Chaudet, Berruer, Rolland, Moitte, Pajou, Cartellier, and Girard.

The practical school of dyeing created at the Gobelins in 1804, thanks to Chaptal and Bertholiet, educated dyers of the first order, who, at Paris, Lyons, Mulhouse, and Tours, founded establishments that were noted for the solidity and perfection of their colors.

In 1805 Count Daru, intendant-general of the Emperor's house, wrote to Guillaumot that Napoleon wished to furnish his palace with magnificence. "The perfection to which the arts have been brought in France permits of introducing into the furniture a sumptuousness that no sovereign could find it possible to equal. The Gobelins manufactory which you direct ought to furnish the means for it. The paintings which your workmen are reproducing with inimitable perfection will henceforth be the principal ornament of imperial houses."

The Exposition of 1806 proved a magnificent success for the Gobelins tapestries, and over the door of the establishment there was a question of placing this distich:

Ici l'art d'Archne, rival de la peinture,
Reproduit les heros, les dieux et la nature.

The manufactory of Beauvais, which was more specially devoted to tapestry for furniture, and which was closed under the Revolution and reopened in the year VIII., entered, like the Gobelins, into the service of the Emperor's house.

Private industries began to awaken from their long sleep, and manufacturers, stimulated by rewards, set their wits to work to extend and improve their productions. Under the old regime, carpets and tapestries were objects of great luxury. It was at the beginning of this century that appeared velvet and short nap carpets of superior quality, as well as common carpets. The former were manufactured at Aubusson and the latter at Felletin. What are now called Axminsters were beginning to come into extensive use, and the centers of their manufacture were at Abbeville, Amiens, and Rouen. Sallandrouze, aided and encouraged by his friend Chaptal, made a model establishment of his manufactory at Aubusson, and his carpets and tapestries were soon distributed throughout Europe. The Savonnerie manufactured carpets and screens, and tapestry for furniture, and carpets for imperial palaces.

The order and security to which everyone was aspiring having restored calmness to the nation, people began to live so much the better in proportion as they had suffered the more. Buildings rose from their ruins, mansions were restored, and needs for the beautiful and the comfortable were manifested on all sides. This was soon followed by a luxury based especially upon sensuality and vanity. Percier and Fontaine, two architects of renown, interpreted with rare happiness the feeling of this republican society, which, in its new life, wished nothing that recalled the old regime.

Taking as an inspiration their studies at the Academy of France and Rome and the work of the painter David, these architects found the definitive formula of the decorative arts of their time. They designed not only the pieces of furniture essential to every mansion, but also goldsmith's work, vases, and table service in a style that was somewhat severe, but with that wealth and elegance of decoration which characterized the finest models of Greek and Roman antiquity. This was the "Empire" style, which has nearly disappeared in our day, and of which nothing remains but a few awkward imitations made ridiculous by gross exaggeration. Lignereux and the Jacob brothers were the skillful artisans who put into execution the ideas of Percier and Fontaine with respect to the furniture and decoration for fine mansions, and Lepaute and Janvier, clockmakers without a peer, furnished the marble, porphyry, antique bronze or ormolu clocks. At this period, the paper hangings and draperies and all the decorative industries concurred in forming a complete and harmonious whole.

As a specimen of the beautiful furniture of the epoch under consideration, we illustrate herewith the bed of Emperor Napoleon I., which formed one of the exhibits of the Exposition of 1806, alluded to above.

For the foregoing particulars and the engraving we are indebted to Revue Internationale des Expositions.

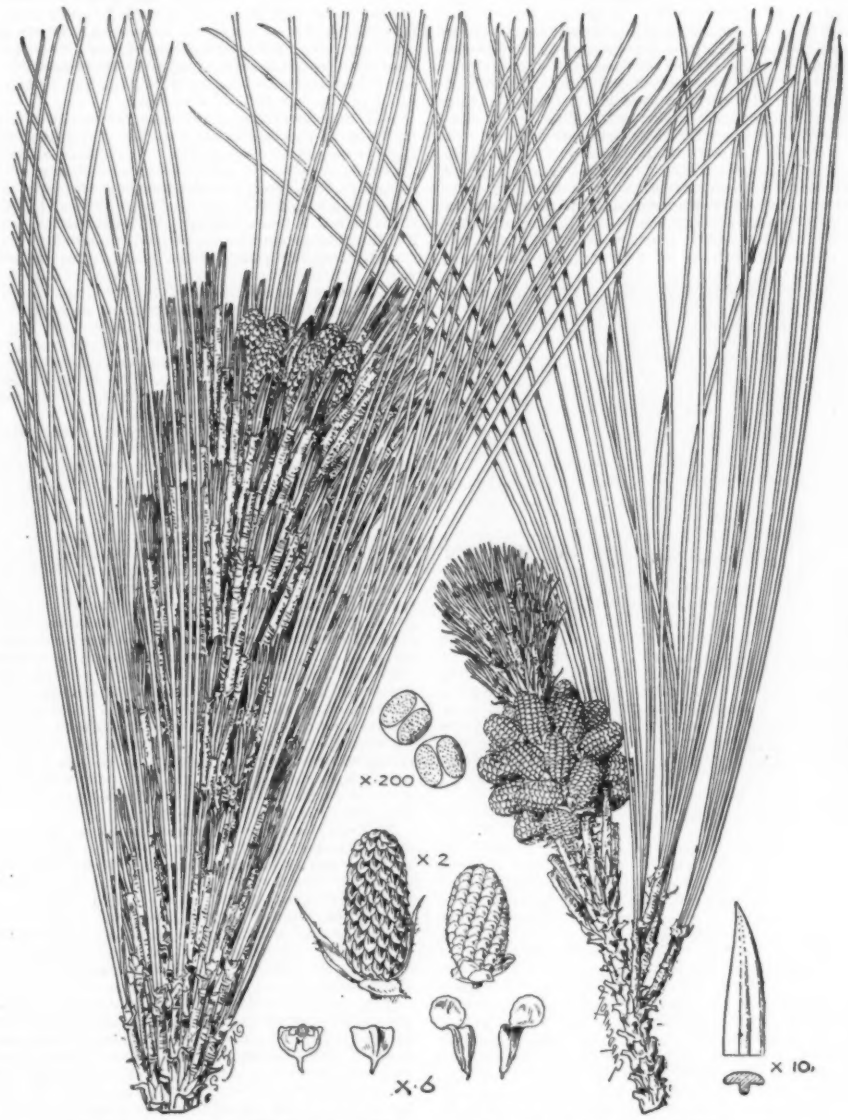
PINUS MONTEZUMÆ.

OUR illustration, taken from specimens obligingly forwarded to us by J. Rashleigh, Esq., Menabilly, shows the foliage, the male and female catkins, together with other details of Pinus Montezumæ. This is one of the most variable of Mexican pines, says The Gardeners' Chronicle, but all the varieties are probably tender in this country, unless in sheltered situations in the south and west. The tree grown by Mr. Rashleigh is now about 20 feet high, and as many feet in diameter. It bore female cones for two years, and last year it had five or six fine cones on it. Mr. Rashleigh raised several seedlings, but all but one damped off; the survivor now looks strong and healthy.

"Very seldom in my experience," says Mr. Rashleigh, "are fertile seeds produced of these Mexican pines. I have had a sackful of cones of P. patula, but no perfect seed. I have about twenty trees of Pinus Montezumæ, each about 7 to 8 feet high, from seed sent to me from Mexico by our consul there, and besides these, I have given away as many more. The two varieties of P. Montezumæ which are growing here are very distinct in the color and form of the foliage. The variety with rigid, upright, glaucous foliage has been called P. Montezumæ vera. The variety with drooping foliage of a bright green color is perhaps the variety Lindleyana.

"Both these varieties have, with me, borne cones, which were similarly curved in shape, but different in the color and form of the scales. My two original largest plants are about the same size and dimensions. That which I had from Lawson under the name P. oocarpa is P. Montezumæ Lindleyana, and the living seedling (home grown) is from this plant, as also are all those which I procured from the consul at Mexico.

"I had several conversations with the late Dr. Lindley about this variety, and I remember my indignation at his refusal to believe that I had succeeded in rearing a cutting of P. Montezumæ into a living plant. He said it was impossible. But I did succeed in doing this, and I reared it from a young growth which had sprung from a broken branch, and by cutting off a small portion of the old wood. It was planted in silver sand with a bell glass over it, the soil being kept constantly moist, so that the bell glass was constantly filled with moist vapor, and was never removed for three or four months."



PINUS MONTEZUMÆ, SHOWING MALE AND FEMALE FLOWERS, POLLEN GRAINS, ETC.

Excluding warships, on March 31 there were 597 vessels of 1,385,715 gross tons under construction in the United Kingdom. On the same date last year, according to the returns of Lloyd's Register of Shipping, there were 606 vessels of 1,185,121 tons building. During the first three months of this year, 162 vessels of 309,250 tons gross have been launched, apart from warships.

PLANT FOODS—THEIR ABSORPTION AND ASSIMILATION.*

ALL living parts of plants are abundantly supplied with water, which is always present in the living protoplasm; and the greater its activity, the more watery its composition. The cell walls of living tissue contain large quantities of water; and in parts composed of many cells, as in the larger flowering plants, even those cells and tissues which have lost their activity generally have their cells saturated with water. In ordinary herbaceous plants the amount of water is not far from 75 per cent. of the whole weight, but varies somewhat in different plants; and in aquatic plants the percentage is much higher, even exceeding 95 per cent. It is so abundant in many of the simpler forms that, upon drying, nothing but an exceedingly thin and delicate film is left.

Protoplasm has the power of imbibing water and thereby increasing its fluidity. Even after it has imbibed all the water which it can retain, it continues the process and separates the surplus into drops in its interior in the so-called vacuoles. Now, an examination of the cell of rapidly growing tissue shows that the protoplasm is much more watery than that of a tissue lying dormant, as in the case of seeds; and one of the first signs of activity that we see in a case of this sort is in the imbibing of water. The avidity of protoplasm for water plays an important part in the economy of the plant. By it all the cells which contain protoplasm are kept turgid, and, by the tension that is created, the soft parts of the plant are made rigid. It plays no unimportant part, also, in the keeping up of the supply of moisture in living tissues which would be wasted by evaporation; as, for example, in the case of flowers which have been cut, we will notice that in a short time the evaporation which takes place from the leaves and the portions of the plant where it had been bruised occasions them to wilt very rapidly. This wilting may quickly be checked by putting the plant into cool water, when the flow of water through the plant is started again. We see examples, however, of cases where the plant has a very thick membrane or covering; as, for example, many plants growing in dry soil. I have in mind particularly our common prickly pear, which occurs abundantly through certain portions of New Jersey, where a portion will live for months after having been broken away from the original plant. In fact, I had a specimen in process of drying from May until October, the plant still keeping green and growing. In one instance which I recall the plant developed quite a large branch.

The wall of the cell is supposed not to be, properly speaking, a membrane which separates the water of one cell from that of an adjacent one, but rather a pervious stratum, composed of solid particles which are not in contact, and between which the water flows freely. In living tissue the water is continuous from cell to cell and constantly tends to be in equilibrium. In the simpler aquatic plants the water of the cells and their walls is continuous with that in which they grow. Likewise the water in the tissues of the roots or other absorbent organs of the higher aquatic plants is continuous with that which surrounds them; and even in ordinary terrestrial plants there is a perfect continuity of the water in the root tissues with the moisture of the soil in which they are growing.

Here it might not be out of place to speak of the roots themselves and their abundant divisions and rootlets, covered with numerous small hairs, which play such an important part in the absorbing of water from the soil surrounding them. The water in the tissue of every plant tends constantly to become in equilibrium, and this state would soon be reached were it not for some disturbing causes which are almost as constantly in action. In any cell an equilibrium may soon be reached between the two forces residing respectively in the cell wall and in the protoplasm. This equilibrium once attained, all motion in the water must cease, and it must remain at rest until disturbed by some other force or forces. This condition—or one approximating it closely—is reached by many of the perennial plants during the winter, or period of rest. During the growing stages of plants, the equilibrium of water is constantly disturbed in one or more ways; first, by the chemical process within the cells; second, by the imbibition power of the protoplasm in the walls of newly formed cells; third, by the evaporation of a portion of the water. The chemical processes within the cell include, first, the actual use of water by breaking it up into hydrogen and oxygen. Every molecule which is broken up leaves a vacancy which, sooner or later, must be replaced. Second, the transformation of substances which are more soluble than those from which they are formed; and the third, the transformation of the substances which are less soluble than those from which they are formed. These processes take place in all plants—even in the simplest. In plants composed of tissues, whenever new cells are forming or developing, the new protoplasm and cell walls require considerable quantities of water to satisfy their molecular contraction. This supply is always made in part or entirely at the expense of adjacent cells. This is invariably the case with the terrestrial plants, and also with the aquatic plants, except in the case of their external cells, where, as I stated before, there is a constant flow of water between the contents and outside. In the aerial parts of plants evaporation of water from the surfaces is a far more powerful disturbing cause than either of the two preceding. Whenever a cell is exposed to dry air at the ordinary temperature, a portion of its water passes off by evaporation. This immediately disturbs the water throughout the remainder of the tissue; and the more rapid or longer continued the evaporation, the greater the disturbance. Evaporation from living cells or tissues is dependent upon a number of causes, some of which are entirely external, while others are connected with the structure of the plant itself. Among the former the most important is the condition of the air as to the amount of moisture it contains. In an air saturated with moisture no evaporation takes place; but when the amount of moisture falls below the point of evaporation, if the other conditions are favorable, evaporation will then take place. The temperature of the air, as a consequence (that of the plant also), has some effect upon the rapidity of evaporation. It appears that there is an increase in the amount of water given off as the temperature rises. This may be due, however, to the fact that at such an increase of the temperature of the air there is generally a decrease in the quantity of moisture.

The direct influence of light upon evaporation is also somewhat doubtful, but there can be no doubt that plants generally lose more water in the light than in darkness. It may be questioned whether this is not mainly due to the increase of heat or dryness, which are common accompaniments of the increase of light.

In all the aerial parts of the higher plants the epidermis offers more or less resistance to the escape of the water of the underlying tissues. This is mainly accomplished by the thick outer wall of the epidermal layers. In many cases, especially in the case of plants growing in dry regions (an example of which I have already referred to in our common prickly pear), they have an epidermis consisting of several layers of cells which offers more or less resistance to evaporation by being themselves filled with moist air only. The stomata of the green and succulent parts of the higher plants control, to a great extent, the amount and rapidity of their exhalation. In the leaves, for example, where, on account of the toughened surface, there can be but little evaporation through the epidermis, it is dependent upon the number, size and condition of the stomata. These are placed over the intercellular spaces of the plant, which are filled with moist air and gases, which, when the stomata open, expand or contract with every change of temperature or atmospheric pressure and thus permit the escape of considerable amounts of water. When, on the other hand, the stomata are closed, the escape of little or no moisture is probable. The opening and closing of the stomata appear to depend upon the amount of light; and they close almost completely in darkness. The amount of moisture in the epidermis appears to affect also somewhat the opening and closing of the stomata. When the epidermis is evaporating, the stomata are generally closed; and vice versa.

The conditions controlling evaporation seem to be many and various. They never, or very rarely, act singly, two or more of them usually acting together, with varying intensity; so the problem of the amount of evaporation taking place at any particular time is a complex and difficult one. It is clear from what has been said that within the polycellular plants there must be a considerable amount of water in some parts to supply the loss by evaporation. Thus in trees there must be a movement of water through the roots, stems and branches to the leaves, to supply the loss in these latter. This can be easily shown by the cutting of a leafy shoot at the time when evaporation is rapid. In a short time the leaves wither and become dry, unless the cut portion of the shoot be placed in water. In the latter case the water will rapidly pass into the shoot and the leaves will retain their normal condition. We

* A lecture delivered March 13, 1899, at the Academy of Natural Sciences, Philadelphia, by Prof. Stewardson Brown, of the Academy. Revised for the SCIENTIFIC AMERICAN SUPPLEMENT by the author.

can easily see how rapidly the moisture—the water—will be absorbed into a plant of any sort by taking a white flower, for example, and putting the stem of it into some colored solution. Several years ago you will probably recall that a number of the florists in the city here sold green carnations. This, of course, was not the natural color of the flower, but was obtained artificially by placing the carnations (white flowers were always selected) in a solution of aniline green, and the rapid drawing up of this green into certain portions of the flower gave it this peculiar green coloring. Some of the veins were very permanently so marked. This I have also seen used in producing red calla lilies, for example, simply by placing the stem of the calla in red ink, when the ink is quickly absorbed through the tissue and makes the spathe—the white portion of the calla lily—a beautiful rose color.

The water in the plant holds in solution several substances; so that it is not water alone, but really a complex solution. Some of the substances in solution are solids, as the inorganic salts, which are taken up from the soil or water; while others are gases, as the air and carbon dioxide, taken up in the water by the roots, or absorbed by the leaves and then entering into the solution in the water. The most important elements which are used in the nutrition of plants—or which, in other words, enter into their food—are carbon, hydrogen, oxygen, nitrogen, sulphur, iron and potassium. These all appear to be necessary to the life and growth of the plant, and if any of them are wanting in the water, soil or air from which the plant derives its nourishment, death from starvation will soon follow. There are other elements, one or more of which are used by plants; but as life may be prolonged without them, they may be regarded as of secondary importance. In this list may be included phosphorus, calcium, sodium, magnesium, chlorine and silicon. With the single exception of oxygen, the elemental constituents just named do not enter into the food of plants in an uncombined state; on the contrary, they are always absorbed in the condition of compounds as water, carbon dioxide and the nitrates, silicates, carbonates, phosphites, sulphates and chlorides of ammonia, potash, lime, iron, soda, and magnesia. In addition to these, many other organic compounds are absorbed in particular cases; as in those of plants which live on decaying animal and vegetable matter, known as saprophytes, as well as those which absorb the juices from living plants, known as parasites.

In the case of aquatic plants, these compounds are taken into the plant body by a process of diffusion from the surrounding water; in the terrestrial plants, the gaseous compounds, as carbon dioxide, carbonate of ammonia, etc., are absorbed—at least in part—by the leaves directly from the surrounding air; while the solutions of these and other compounds in the water and the soil find their way into the plant by diffusion.

Once within the plant body, this food material is diffused to all watery parts and in the case of the larger terrestrial plants rising through the stems and leaves. By diffusion there is a constant tendency toward an equal distribution throughout the plant of the solutions which enter it; and if there were no disturbing chemical or other action taking place, such a condition would in most plants be soon reached. Doubtless the rapid diffusion of food materials throughout the terrestrial plant is aided by the evaporation of water from the leaves, thus causing a strong forward movement of the water, which contains the various solutions of food matter. Moreover, there can be no doubt that the movement of water in terrestrial plants caused by the swaying and bending of the branches and stems facilitates and hastens the diffusion of food materials. In many plants the food materials which are taken into the body are of such a nature that they can be directly used by the protoplasm. Thus in the saprophytes the solutions of organic compounds derived from the decay of the animal and vegetable tissues are imbibed by the protoplasm and used by it as food; and in parasites the protoplasm and juice of living tissues are used in a similar way. It is also probable that in some of the lowest forms, as, for instance, in the slime moulds and in the bacteria, the protoplasm is capable of making, to a limited extent, a direct use of some of the inorganic substances absorbed by them. For the most part, however, the particular food materials taken in by plants, as such, cannot be used by the protoplasm in either its vegetative or reproductive activity in their entirety. Thus, neither water nor carbon dioxide is directly used as food by the protoplasm of ordinary green plants; but in all cases they embody certain chemical changes before they are rendered of use to the plant.

These preparatory changes which build the crude food materials for protoplasmic food are known under the general name of assimilation. It is impossible to give the complete statement of all the processes of assimilation; but we know that in chlorophyl-bearing portions of plants carbon dioxide and water are decomposed; and from their component elements the carbohydrates are at once formed. This decomposition, or subsequent combination, takes place only in the granules or masses of the chlorophyl in sunlight. Those parts of the ordinary plants which are entirely destitute of chlorophyl are entirely wanting in the power of assimilation; and, likewise, the chlorophyl-bearing portions are unable to assimilate in the darkness. Through this process, various chemical changes take place—the formation of starch, oils, sugar and other reserve materials; but such changes take place only in the chlorophyl-bearing plants and parts of plants, and in those, only in sunlight. In cells which are destitute of chlorophyl, and in the chlorophyl-bearing ones in the absence of light, other chemical changes take place; and these, while differing among themselves, agree always in being processes of oxidation and the change of one organic compound to another. To these chemical changes, in order to be distinguished from those of assimilation, the term metastasis has been applied.

The nutrition of parasites and saprophytes is similar to that of the embryo and buds, etc. These assimilated materials are drawn from some other organism and here undergo this second chemical change. In some cases this change is only practical in the part occasioning the assimilation of these various products. In parasites there is only a partial change of this sort; because, in the case of the mistletoe, for example, they have a green portion which contains chlorophyl, and by it, it is enabled to create certain chemical actions which take place through the aid of the chlorophyl, and in addition extracts the mineral salts and other substances from the host plant on which it lives. Many of the cultivated plants as we grow them are practically saprophytes, deriving a portion of their nourishment from the decaying organic matter in the soil. The so-called carnivorous plants, as, for example, the Venus' fly-trap, the little sundew, the pitcher-plants (Sarracenia Darlingtonia) and the Nepenthes of the tropics, also the bladder-worts (which are aquatic plants), are really partially saprophytic, obtaining a considerable portion of their food materials from decaying animal matter on which the plants feed. It will be seen from what has already been said that in chlorophyl-bearing plants the various chemical changes take place by assimilation; and in the non-chlorophyl-bearing plants (such as in the large class of fungi and other lower forms closely allied) that the change takes place by this other chemical process—metastasis.

During these processes carbon dioxide is freely taken in by the plant, as forming an important constituent of its food; and oxygen is freely given off. We see that chlorophyl is the great agency by which these chemical changes can take place. The exact function of chlorophyl is to apply the action of the sun's rays in the production of various forms of carbo-hydrates which are not starch, but which are closely related to it. One of the functions of the living organism is to take in materials different from itself and change them in chemical composition and perfect them for its use. Some require that the material be complex in form, while others are able to make use of them in a simple state. Animals and chlorophyl-bearing plants are dependent for their vitality on the energy supplied by the oxidation of the complex food materials which they take into their bodies; but chlorophyl-bearing plants are able to do additional work. They can make use of the energy of the sun's rays in constructive work. By their aid they construct, from the mineral constituents of the earth and air, complex organic matter which afterward is used partially by themselves, partially by the other plants and animals, in carrying on the vital processes and so building up the organic tissues, and by this means the plant is able to draw—and it only—a perpetual supply of power from the sun; and without it, it is difficult to conceive how life (save possibly in some of the lowest forms) could exist on the earth.

We have now seen how important a part water plays in feeding plants; as it is the most powerful of all solvents, and it is only by it that mineral substances are dissolved and thus transmitted as the food of the plants and, through them, to animals. Undoubtedly, the first life on the earth was plant life; because, as we know, in the animal kingdom there is such an amount of carbonic acid gas exhaled and given off that if there were not something to counteract this, in a short time there would be no life, and here the plant steps in to take up this carbon dioxide and through the aid of the chlorophyl bodies to transform it into various food materials for the plant, and by the exhalation of oxygen (which is so important to the life of animals) makes the life of the animal absolutely dependent on the plant. For example, while in the case of the carnivorous animal it lives on flesh; yet the animals on which they live are invariably animals which are herbivorous in their habit; and we know how, in our own cases, in the case of the human race, how absolutely essential vegetable matter is in order that the body may be kept healthy. I might refer here to one substance—one of the constituents of plant food which is a most important one, and which forms one of the principal constituents of the air which we breathe—nitrogen. Plants in themselves have little or no power to take the nitrogen from the air. They are absolutely dependent on the earth in which the plant is growing for their supply of this; and it is for this reason that it is necessary, in order to produce satisfactory crops, that the soil should, at certain periods, be heavily manured, in order that these nitrates which the plants absorb so freely from the soil should be replaced. We have, however, one group of plants which has this power of extracting the nitrogen from the air through the aid of another plant which is parasitic upon it. In all of the plants, or the majority of the plants, belonging to the Leguminosæ, or the clover and pea family, we have on their rootlets (the hair-like roots which are growing rapidly) small organs which are developed through the agency of a bacterium. This bacterium attacks the roots of the plant, and through its action the plant extracts large quantities of nitrogen from the air which is stored in these small bodies. It is for this reason that so many plants of this particular order—notably the cowpea and the crimson clover—are grown so extensively at the present time; as they are found to be such excellent manures. It had been known for a long time that the plants of this particular group were of particular value in this way; but it was not known exactly what was the occasion of it. Experimentation in Germany and recently in our own country has proved what the occasion is; as I have previously stated, being a small bacillus, which is parasitic on the roots of these plants and which occasions the plant to store large quantities of nitrogen; and at the present time, farmers planting this crimson clover have come to drill in, with the seed, soil in which the clover had previously grown; as this soil contains the bacillus. In fact, I noticed recently in the catalogue of one of our seedsmen that they advertise that this year they would be able to furnish to their customers this soil so inoculated, in order that the products, of whatever the plant might be, on which it would be used would be stronger and more vigorous. I have here a specimen of our common red clover which I dug up in the yard of the Academy this afternoon which will show on some of its rootlets these small organs to which I have referred. Of course at this season of the year the plant is not growing very rapidly; but as the plant starts to grow more rapidly, these organs will become quite large and very apparent; in fact, in seedling clovers I have often seen these little tubercles on the roots fully an eighth of an inch or more in diameter, showing how very large they get. Even if the plant should have but one or two very small rootlets (the root exposed not probably exceeding more than a few inches), then these small tubercles will be noticed on the roots of, say, oftentimes as much as an eighth of an inch in diameter.

THE EXTERMINATION OF THE MOSQUITO.

By HENRY C. WEEKS.

CAN the mosquito be exterminated or can it be so lessened as to diminish its evil effects?

This is an interesting question, and the mere statement of it discloses the fact that it is the old story of the woman working the trouble, for it is the female in this case; surely that is largely the cause of the evil. She it is who does the stinging, and, though the male may contribute to the music in the air, he is powerless to sting.

While April and May are ordinarily the months when chemical remedies should be started, yet on account of the lateness of the present spring, probably May and June work would be productive of much relief, and then the work should be kept at periodically during the warm breeding weather.

It is safe to say that the press of the country will gladly record the efforts and successes of any organization operating for the reduction of this evil to the point where it ceases to be troublesome in a community. But until this hoped-for end shall be reached, we may use the remedy given in an interesting article on the mosquito in the New York State Entomologist's Report for 1897 as the most efficacious in keeping off the pest, namely, the application to the hands and face of a small quantity of the oil of tar combined with a little carbolic acid.

While the mosquito nuisance is not as great here as in countries where, to get sleep, the natives have to bury themselves in sand or swing themselves in hammocks over fires, it is still of such proportions as to affect the values of property in sections where they prevail, and even to cause some of our most picturesque localities to become depopulated and to render outdoor life miserable when otherwise there is so much of delight in the freedom of the open.

But as serious as are these charges, the most serious indictment yet framed is that the mosquito carries and injects the germs of malaria. Certain it is that the two go together almost universally, and it might be an instructive work to try and ascertain whether they ever really exist separately, and if so, wherein the conditions differ from the usual case. Whether their coexistence is simply because the two thrive on similar conditions, or whether the pest carries the disease, is not yet determined.

The theory that malarial fevers are caused by the punctures of mosquitoes is gaining more and more acceptance in European medical circles. It was believed to have been originated in 1894, by Dr. Bignami, an Italian doctor. But it is now known that it was first formulated by an American, Dr. A. F. A. King, in a paper read on February 10, 1883, before the Philosophical Society of Washington.

A commission from Germany, with the distinguished Prof. Koch at its head, has recently visited malarial sections in Italy and reports in no vague way the results of its researches. In the Berlin correspondence of The London Standard, it is said that Dr. Koch is of the opinion that mosquitoes are, in reality, accountable for the spreading of malarial parasites and carry them from one person to another. They are the middlemen of the parasites. In support of the mosquito theory, Dr. Koch refers to observations on the local spread of malaria in and about Rome. The city of Rome lies in the midst of an extensive malarial district, but is itself free from malaria, at least in the interior. The cause of this immunity cannot lie in the air or in the water or in the food. The only notable distinction between the town and its surroundings is that the inner portion of the town is devoid of vegetation, and therefore entirely free from mosquitoes, whereas the surroundings swarm with gnats of various kinds. Everywhere where vegetation is to be seen in large gardens and other places gnats appear within and without the walls of Rome, and with them is associated malaria.

So important is the subject and so far-reaching its effects that a great corporation—the Mexican Central Railway—is seeking a solution of the question, and the company has appointed a commissioner to make an exhaustive study of the evil and seek its remedy. When great corporations like this, usually so unconcerned in such matters, are examining the question, it is surely time for boards of health, of public improvements, and of local society improvement to look into the matter.

The result of this railroad company's experiments around the depot in Mexico city is that people are now troubled very little, whereas before the mosquitoes were a great annoyance. They had only been able to kill the pest in its egg form until this spring, when, it is claimed, they discovered a solution that will destroy the larva as well as the egg. As a result there has grown out of their work the manufacture of the compound which is shortly to be marketed at Chicago.

The Public Health Journal last spring put forth the statement, and the SCIENTIFIC AMERICAN gave it wider publicity, that the mosquito in all its phases may be instantaneously killed by contact with minute quantities of permanganate of potash. The following is a description of how this chemical affects the pest:

"Two and one-half hours are required for a mosquito to develop from its first stage, a speck resembling cholera bacteria, to its active and venomous maturity. The insect in all its phases may be instantly killed by contact with minute quantities of permanganate of potash. It is claimed that one part of this substance in 1,500 of solution distributed in mosquito marshes will render the development of larvæ impossible; that a handful of permanganate will oxidize a ten acre swamp, kill its embryo insects and keep it free from organic matter for thirty days at a cost of twenty-five cents; that with care a whole State may be kept free of insect pests at a small cost. An efficacious method is to scatter a few crystals widely apart. A single pinch of permanganate has killed all the germs in a thousand gallon tank.

"This is a subject of practical consequence to a large part of New Jersey, for if the mosquito can be suppressed, it would add to the value of all property there. The belief has been generally held that the filling in of the meadows with the ashes from nearby cities would prevent the development of these pests, and the providing of a place for the ashes would be another good. It is doubtless true that the potash which would leach from ashes will—like a solution of the permanganate

of potash—render the development of insect life impossible."

Where or by whom these results were obtained is not stated, but the test can easily be made in a barrel of stale rain water.

We draw attention to and commend the action of the Good Government Club, of Flushing, L. I., which is discussing means of reducing the insect troubles of their beautiful section, though the pest is far less serious there than in many other places. They purpose to undertake a campaign of education, and are to distribute the potash remedy as they are able. It is to be regretted that the experiment could not be made general in that section or any other as a test. They publish a recent letter from County Judge Curtis, of Stratford, Conn., in answer to their inquiries, which shows that engineering means are important and highly efficient in a campaign. No more beautiful town exists in New England than Stratford. But it was seriously cursed with the mosquito pest. Judge Curtis says:

"We have solved the mosquito problem at Stratford. We have about 2,000 acres of salt meadow lying south of the town. It is cut up by numerous creeks from the Sound. We found that the tide kept this land saturated like a sponge full of water. When it rained, the fresh water could not soak away on account of the saturated condition as above described. Therefore the rain water or the most part formed shallow pools on the surface, and in there the mosquito flourished.

"A dike two or more miles in length was built across the meadows so arranged as to shut out a portion of the tide water. The tide rises inside the dike to within eighteen to twenty-four inches of the surface of the meadows. This leaves the top of the meadows not saturated as before, the rains therefore sink away as upon the upland, and the mosquito is homeless and we are happy."

It is work similar to this, but on a more extensive scale, that Engineer Vermeule outlines in the annual report of State Geologist Smock of New Jersey for 1897, on the reclamation by the State of the tide marshes of the Hackensack and Newark. But while this work is intended to improve the sanitary conditions as well as increase realty values for the meadows and the surrounding uplands, yet he claims, and it is universally conceded, that incidentally the great question of the evils of the mosquitoes there bred would be solved.

The conditions are quite the same in this section and that of Stratford, as well as of much of the section about the metropolis; the surface pools are only brackish from rain or from seepage, and mosquitoes breed in quite brackish as well as in perfectly fresh water.

It is a matter of great surprise when we consider how little has been done in this progressive country, especially near the metropolis, where such vast interests are involved, toward the reclamation of marsh lands as compared with Holland for example, where 840,000 acres have been reclaimed, some having been covered with water thirteen feet deep, and some portions of the land reclaimed now lying twenty feet below sea level. An instance is given in the above report where, in eighteen years, the land was estimated to be worth considerably over double the cost of the drainage. The work proposed for Hackensack Meadows, where, instead of being below the land is above high tide, dwindles into insignificance in comparison, and so it is with most of the tide marshes in Greater New York and vicinity.

What is needed to rid our section largely of this pest is concerted action by some organization, or better, by the authorities, first in the drainage and second in the use of insecticides. An interesting result was found by the reclamation of the marshes of the Potomac about Washington, where previously mosquitoes were a great pest, but now the city is singularly free from them. But engineering work, which is expensive, and, if it be done on a large scale, should be undertaken as a public work, is not the only means of relief, nor is the potash remedy the only one, as is clearly shown in Bulletin 4, New Series, Department of Agriculture, Division of Entomology, Washington, 1896, in an article by Dr. L. O. Howard.

Instances cited from one end of the country to the other show the mosquito thrives in all suitable places and under all our temperatures, from Alaska to Texas. He says that kerosene has long been successfully used as a destructive agency, a small quantity being sufficient to destroy life and prevent breeding by forming a slight coating on the surface, and thus preventing the larvæ from reaching the air in addition to the actual insecticide effect of the oil; his experiments proved approximately that one ounce of kerosene to fifteen square feet of surface used once a month will ordinarily do the work, and that since 1892 several demonstrations on both a large and on a small scale have been made—two localities being rid of the plague under his supervision by the use of kerosene alone. The mosquito will breed in open vaults or cesspools; only by concerted action of a community in the use of kerosene alone in these breeding places can the plague be greatly diminished, the city of Baltimore, Md., being a notable example in this respect.

The breeding or installing of fishes as recommended by some can only be of service in destroying the young mosquito when they are used in permanent pools or ponds, and the remedy of agitating the waters by a windmill or otherwise, when the pest is in its pupal stage, can only have limited operation, where, for instance, rain water is stored in tanks or reservoirs.

LUMINOUS SPECTERS.

THE optical illusion in which the image of a person is observed alongside of a real individual upon the stage of a theater is familiar to every one. This trick, first brought out under the name of "Pepper's Ghost," and which is often exhibited in one form or another by prestidigitators, may be performed by any one very simply and with a few cheap materials. Take a pane of window glass and support it in a vertical position by means of two heavy books, as shown in the figure, and in front of and behind it place a playing card supported by a pin. Then place a candle near the glass. By causing the light to approach or recede from the latter, one will soon succeed in placing a very distinct specter of the card in front of the glass alongside of the one behind it.—Tissandier, in La Physique sans Appareils.

TOILET AND MEDICINAL SOAPS.

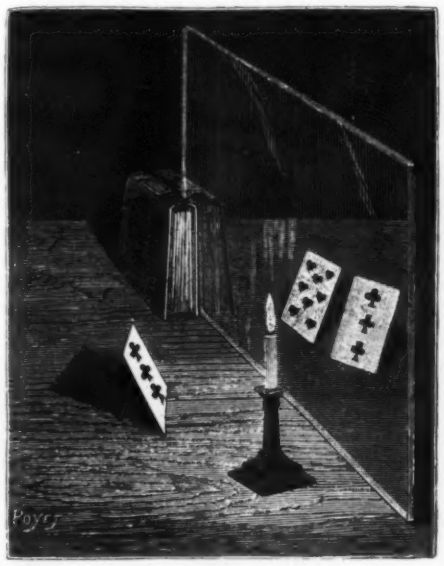
PROCESSES AND FORMULAS.

WE frequently receive requests from our readers for formulas for some particular kind of toilet or medicinal soap, but the manufacture of these soaps embraces so much which is outside of the ordinary routine work of pharmacy that it is impracticable to give any mere formula which would be of any value without some general explanation of the subject. The following is based principally upon the chapter on soaps contained in the latest edition of Buchheister's "Vorschriftenbuch für Drogisten" and furnishes the information necessary to make the formulas comprehensible.

The greatest variety of methods are employed in the preparation of toilet and medicinal soaps, and the "blank" soap used as a basis for their preparation also varies very widely in its composition. The cheaper kinds of toilet soaps are made from the lowest grades of "filled" soaps, a term applied to soaps containing a large admixture of foreign inert substances, such as talcum, clay, etc., but the better qualities of the toilet soap are, as a rule, made out of mixtures of pure olive oil and tallow. Where the manufacture of toilet and medicinal soaps is to be undertaken on a limited scale, it is advisable to purchase the soap base from a large manufacturer. This is the method generally followed in England, and to a considerable extent in America and in Germany. The conversion of such soap into a cosmetic or toilet soap may be carried out in either one of two ways; namely, the entire operation may be conducted in the cold, the plain soap being cut into shavings, and the necessary coloring matter and perfume being added in the mixing machine. As above intimated, this method is to be preferred where the perfume used is at all delicate. In the second process the soap base is cut into shavings and is melted in a water or steam bath, and the required perfumery and coloring matter added, and the melted soap then poured into moulds and allowed to cool. If very hard water-free soap is purchased to begin on, 10 to 15 per cent. of water may be added in the water bath.

The following requirements may be laid down for a soap suitable for medicinal or toilet use:

(1) The soap must be completely neutral, since "filled" soaps or those containing lye irritate the skin.



LUMINOUS SPECTERS.

(2) The amount of moisture present in soaps intended for cosmetic purposes must not be too small, for thoroughly dried soap is too insoluble and makes too little lather to be quite satisfactory. On the other hand, an excess of water also detracts from the value of the soap.

(3) Lathering is prevented by the presence of uncombined fat. Such soap also becomes rancid on standing. Nevertheless, it should be borne in mind that the superfatted soaps have marked cosmetic value in some instances, though not particularly suitable for cleansing purposes. The occurrence of rancidity and stickiness in the superfatted soaps may be prevented by using lanolin instead of fat for the final 8 to 10 per cent. of fat which is added after the saponification is complete.

(4) The soap should present a fine, uniform, and permanent color, and if it is to be used for medicinal purposes, must be entirely free from any harmful qualities.

The most important of the hard soaps are mentioned below:

In Germany, and more particularly in Russia, tallow soap is very popular. It is very firm, makes but little lather, but gives excellent service in cleansing.

Olive oil soap has been made of the poorer qualities of olive oil throughout the south of Europe in very large quantities for a long time. Considerable quantities of oil of sesame are used in conjunction with olive oil in making this soap. It comes into the market under the name of Castile, Marseilles, Venetian, or Spanish soap. It owes its reputation as a mild soap suitable for use in washing delicate fabrics to the fact that it is entirely free from any lye and comes into the market thoroughly dry. Recently these qualities appear to have been somewhat neglected. At least large quantities of water glass have been exported from Germany to those districts in which this soap is made.

On account of its yellow color and its peculiar odor palm oil soap is only available for the commoner uses.

Pure cocoanut oil soap is a very white and hard soap, but has a disagreeable odor which is very persistent, although it can be covered to a certain extent by some other odor, particularly that of myrbane. It forms a copious lather, but generally has a disagreeable effect on the skin on account of the large quantity of free alkali present. For this reason it is usually utilized in combination with other fats which overcome this defect.

TRANSPARENT SOAPS.

Transparent soaps are prepared by mixing the desired quantity of soap with an equal quantity of alcohol in a water bath and preferably with the condenser attached, so as to recover any alcohol which may be driven off by the heat. The soap is warmed until dissolved, the solution set aside until it becomes clear and then poured into moulds. After several weeks the mass will have become hardened and may then be cut and pressed in moulds. This soap is generally erroneously known as glycerin soap.

Genuine glycerin soap is made in the same manner as the so-called "transparent" soap, save that pure glycerin is used instead of alcohol.

HINTS ON MANUFACTURING.

Of late years the superfatted soaps have grown greatly in popularity. These may either be prepared by adding a sufficient quantity of alkali to the oil so as to only partially saponify it, or it may be made by adding 10 per cent. of the oil itself to a soap which has been completely freed from any excess of alkali. In either case the fat is emulsified throughout the soap. Such a soap fulfills its purpose admirably for medicinal use so long as it is fresh, but its marked tendency to decomposition and rancidity is a decided disadvantage. This tendency can be overcome as before indicated by using lanolin instead of fat for the excess of fat required.

In fine toilet soaps where a superfatted soap is not desirable, and also in such medicinal soaps as permit of the use of a neutral soap, the superfatted soaps should not be used, the preference being given to pure neutral "kern," curd, or grain soap, which has been wholly freed from excessive lye by means of a centrifuge. By way of explanation it may be said that the term "kern" or curd is applied to hard soaps, which are made by precipitating the soap from the lye by the addition of salt.

PERFUMING SOAPS.

The methods used in perfuming toilet soaps also vary widely and depend much upon the quality of the soap being made. In the cheaper kinds the low priced and powerful perfumes are used, being stirred into the semi-liquid soap mass while it is yet warm and before it is poured into the moulds. In the finer soaps, however, the perfume is usually added while cold. The soap in these cases is cut up into shavings, the perfume poured over the shavings and the whole mixed in a special mixing machine and the mass eventually pressed into the desired shape. This method has the advantage that the odors are less changed than when the perfuming materials are added to the warm soap mass. The excess of lye contained in the cheaper soaps acts upon the perfumes, causing a gradual change which frequently results in the production of a very disagreeable odor after the soaps have been standing for some time.

In soaps intended for special purposes, foreign substances such as sand, powdered pumice stone, oxgall, or medicinal substances are added, the soap then being used as an external medicament. Latterly the use of these so-called medicinal soaps has increased very rapidly. When properly prepared, medicinal soaps are made from a "blank soap" or soap base, which is either absolutely neutral and entirely free from any lye, or from a "superfatted soap," that is, one to which 8 or 10 per cent. of free fat has been added after the soap has been made and separated from the lye. In soaps of the latter class very delicate chemical substances remain unchanged.

The perfuming of soaps is by no means an easy task, since not all ethereal oils are suitable. Those possessing the most powerful odors are best adapted for this purpose. The chief oils in point of importance are lemon, bergamot, lavender, rosemary, caraway, thyme, citronella, lemongrass, and latterly a great deal of saffrol has also been used as well as ordinary camphor oil. For the finer soaps, oils of rose, rose geranium, orris, etc. As has already been indicated, the more delicate perfumes are incorporated into the soap mass by means of a mixing machine, and the deleterious effect of heat upon the perfume is thus avoided.

COLORING SOAP.

Of late years there has been a growing tendency to utilize the coal tar colors for soap, but while these yield very beautiful color effects they are open to objection on account of being sensitive to light. Corallin, fuchsin, cinnabar, and carmine are used as oil coloring agents, though the latter can be used only with completely neutral soaps. For the cheaper soaps, Venetian red and similar earthy colors may be employed.

For producing a yellow color, annatto, cadmium yellow, yellow cinnabar, saffron "surrogate," and picric acid may be used, but these latter agents are not available for cosmetic or medicinal purposes.

A brown color may be produced by the use of burnt ocher, umber, etc. Ultramarine and cobalt blue are used for giving a blue color, while a green tinge may be imparted by using mixtures of the blue and yellow coloring matters in suitable proportions.

The soap pressers, which may be worked either by hand or by power, are generally fitted with a variety of moulds suitable for the various kinds of medicinal or toilet soaps which are to be made. Where the cheaper kinds of soap are being made, the soap mass with which the perfume and coloring has been mixed by the aid of heat and then poured into moulds and allowed to harden is cut into blocks of the required weight and these blocks are placed in the moulds and pressed into shape. In the finer soaps, however, the shavings themselves are fed into the pressing machine and compressed into the form required. The general instructions given will enable the reader to utilize any of the following formulas without the necessity of our giving any detailed instructions in connection with each particular formula.

TOILET SOAP FORMULAS.

Almond Soap.

Tallow curd soap	750 parts.
Castile soap	125 "
Cocoanut oil soap	125 "
Oil of bitter almonds (free from hydrocyanic acid)	10 "

The common almond soap of the market is composed generally of cocoanut oil soap alone, perfumed with

oil myrbane, and has all the disagreeable qualities inherent to cocoanut oil soap, which are referred to in the introduction to this article.

Almond Meal Soap.

Tallow curd soap	900 parts.
Rose water	50 "
Bitter almonds	50 "

Peel the bitter almonds, pound into a smooth mass with the rose water and stir in with the melted soap, adding any desired perfume.

Musk Soap.

Tallow curd soap	1,000 parts.
Musk	3 "
Oil of bergamot	10 "
Burnt sugar coloring, a sufficient quantity.	

Triturate the musk with granulated sugar to a thoroughly fine and uniform powder and add this to the soap base previously cut up into shavings. Add sufficient burnt sugar coloring to produce a light brown color. If desired, artificial musk or tonquinol may be substituted for the musk itself.

Patchouli Soap.

Tallow curd soap	1,000 parts.
Oil of patchouli	5 "
Oil of rose geranium	2 "
Oil of vetivert	2 "

This soap may be made by melting the base and adding the oils to the melted soap.

Rose Soap.

Best curd soap	1,000 parts.
Rose water	50 "
Cinnabar	10 "
Oil of rose geranium	8 "
Powdered talcum, a sufficient quantity.	

Melt the soap on a water bath with the rose water, add the cinnabar and oil, and finally add as much talcum powder as the soap will take up.

Violet Soap.

Finest curd soap	3,000 parts.
Oil of orris	3 "
Oil of rose geranium	1 "
Tincture of musk	6 "
Oil of bergamot	18 "
Oil of bitter almonds	1 "
Tincture of civet	6 "
Burnt sugar coloring, a sufficient quantity.	

Brown Windsor Soap.

Tallow curd soap	800 parts.
Castile soap	400 "
Oil of caraway	2 "
Oil of lavender	2 "
Oil of thyme	2 "
Oil of bergamot	2 "
Spanish oil of hops (?)	2 "
Burnt sugar coloring, a sufficient quantity.	

Mix cold.

Transparent Glycerin Soap.

Tallow curd soap	600 parts.
Glycerin	500 "
Coloring matter, a sufficient quantity.	
Perfume, a sufficient quantity.	

Melt the curd soap on a water bath, add the glycerin, mix thoroughly, and then stir in any desired coloring matter and perfume and pour the liquid soap into moulds. This requires several weeks to harden, after which it may be cut and, if desired, pressed. This genuine glycerin soap has the advantage over the so-called glycerin soap which has been rendered transparent by the use of alcohol, that it is more permanent.

Struve's Non-transparent Glycerin Soap.

Tallow	260 parts.
Cocoanut oil	130 "
Potash lye, 30 per cent	40 "
Lard	260 "
Soda lye, 25 per cent.	270 "
Glycerin	40 "
Oil of bitter orange	7·5 "
Oil of bitter almonds	2 "
Oil of bergamot	5 "
Oil of vetivert	1 "

Melt the fats, add the lye at 40 to 60 degrees temperature, mix thoroughly, then add the glycerin and finally the perfume.

Sarg's Liquid Glycerin Soap, According to Paschkis.

Olein potash soap	334 parts.
Glycerin	666 "

Perfume with a mixture of rose and neroli oils. The genuine Sarg's liquid glycerin soap is completely free of any alkali. Since it is difficult to prepare potash soap entirely free from alkali, it is probable that the soap has been precipitated out with potassium chloride just as the soda soap is precipitated out with sodium chlorides.

Dieterich's Liquid Glycerin Soap.

Potash soap	600 parts.
Sirup	600 "
Oil of cassia	2 "
Oil of sassafras	4 "
Oil of citronella	1 "
Oil of wintergreen	2 "
Oil of geranium	2 "
Oil of clove	1 "
Oil of bergamot	6 "
Oil of myrbane	1 "
Tincture of musk	1 "
Glycerin	600 "
Alcohol	600 "

Mix ingredients, allow to stand for a day and then filter. What particular effect is produced by the sirup is not apparent. Paschkis, who observed that the use of sugar was quite common in England, looked upon its use as a gross adulteration, and it would probably be better to substitute glycerin for the sirup.—American Druggist.

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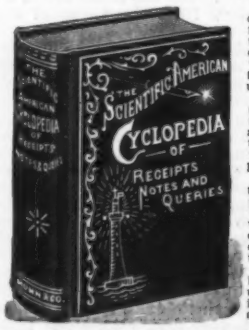

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PAGE

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The Maxim Smokeless Powder Controversy. 19560

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Double-Cylinder Steam Fire Engine, London County Council.—1 illustration. 19564

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PAGE
..... 19632
..... 19630
e.—I
..... 19635
..... 19635
Tem-
etals
..... 19635
nne
..... 19636
ls. 19637
By
..... 19640
..... 19642
..... 19640
nde.
..... 19642
..... 19642
Ex-
..... 19643
En-
..... 19644
il.—
..... 19644
..... 19645
..... 19646
..... 19646
..... 19646
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